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WEISS (F.) & SMITH (F. F.). **A Flower-spot Disease of cultivated Azaleas.**—*Circ. U.S. Dep. Agric.* no. 556, 28 pp., 14 figs., 1 ref. Washington, D.C., 1940. [Recd. 1941.]

A description is given of the symptoms of a destructive disease of the flowers of cultivated azaleas that occurs in the south-eastern and Gulf regions of the United States [*cf. R.A.E.*, A **26** 328]. It was first observed in 1931 in South Carolina and is caused by a fungus that was described in 1940 as *Ovulinia azaleae*. The sclerotia, or resting bodies, are produced in the flowers and overwinter in the soil. In the spring, during the early part of the flowering season, fruiting bodies develop ; the resulting spores may infect relatively few flowers, but the conidia (secondary spores), which are produced in large numbers on the initially infected flowers, are responsible for widespread and destructive outbreaks of the disease. Since its rapid spread in a planting did not appear to be entirely due to wind or rain, it was suspected that insects might be involved. Scratches that were observed in the throats of azalea flowers were found to be caused by claws or spines on the legs of visiting bees, and the first flower-spot infections of the season were frequently observed on flowers bearing typical insect abrasions, but in experimental transmission tests with insects, over 92 per cent. of the infections developed in the absence of visible mechanical injuries.

In the early investigations on insect transmission of the fungus, microscopic examination showed that insects taken on diseased azalea flowers carried spores on their legs and heads, and during the 4 weeks of greatest bloom, an average of 20 per cent. of all insects tested caused infection. Among the insects that were at times very abundant on azaleas, *Frankliniella tritici*, Fitch, and *Heterothrips azaleae*, Hood, caused very few infections. Four species of bumble-bees (*Bombus* spp.), *Emphoropsis floridana*, Smith, and carpenter bees (*Xylocopa* spp.) appeared to be the most important agents of dissemination, although honey-bees caused infections in a few tests. No infections were caused by pollen taken from various species of bees on inoculated flowers, although the bees from which it was taken caused infection.

Investigations were made in 1937–38 to discover whether insects initiated infection in azalea gardens. At the times when infections were observed among the earliest flowers, honey-bees were almost the only flying insects present, and they were visiting camellias. All insects taken on or near azalea flowers for three weeks after the appearance of the disease and many thousands of ants taken on azalea plants or in bait traps beneath plants that had shown infection in the previous year failed to initiate infection. The first infections by an insect were obtained with bumble-bees taken about three weeks after the disease had appeared. Occasional infections occurred in subsequent tests with bumble-bees and carpenter bees, and, as the disease reached epidemic proportions, the percentage of infective insects exceeded 90 and a single bee infected as many as 107 flowers. These results indicate that insects are not responsible for bringing the disease into azalea gardens, but that they become efficient carriers when infected flowers are already abundant. In investigations on the distances covered by these insects, the maximum observed was 5 miles in the case of a bumble-bee captured 8 days after release. Bees were observed to visit flowers of *Rhododendron nudiflorum* and

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Vaccinium spp. in woods near affected azalea gardens, and in one case flowers of *R. nudiflorum* growing ½ mile from the nearest cultivated azaleas and showing typical feeding punctures of *Xylocopa* were found to be infected with the fungus. No natural infections have been observed on wild *Vaccinium,* although, in experiments, both it and *R. nudiflorum* have been infected by means of insects.

In a discussion of possible methods of controlling the disease, it is pointed out that local transmission by insects might be prevented by the provision of a succession of plants that would be in flower over the normal flowering period of azalea, since it was apparent that, with the possible exception of *E. floridana,* all the bees prefer flowers other than azalea. In tests of insecticides, standard contact dusts containing derris, pyrethrum or nicotine sulphate had no apparent effect on *Bombus, Xylocopa* or *Emphoropsis,* whether applied to the insects or to plants on which they were subsequently caged, and fungicidal dusts incorporating 15 per cent. lead arsenate, 20 per cent. sodium fluosilicate or 10 per cent. Paris green gave no control in cages. The most favourable results were obtained with a bait of 5 per cent. cane syrup in water to which was added nicotine sulphate (1 : 200), derris powder to give a rotenone content of 0·0107 per cent., or tartar emetic (1 : 400), but all these materials were ineffective when sprayed on flowers in the garden. Moreover, although insects are important vectors under certain conditions, their elimination will not materially affect the seasonal progress of the disease in infected gardens, and measures against the fungus itself are essential.

Service and Regulatory Announcements, April-June 1941.—*S.R.A., B.E.P.Q.* no. 147 pp. 45–63. Washington, D.C., U.S. Dep. Agric., 1941.

In Administrative Instructions (B.E.P.Q. 499 supplement no. 1 third revision) relating to Quarantine no. 48 against the Japanese beetle [*Popillia japonica,* Newm.], the fumigation with methyl bromide by a method already described [*R.A.E.,* A **27** 591 ; **28** 490] of plants with bare roots or roots in pots or soil balls up to 12 ins. in diameter is authorised at dosages of 2½ lb. methyl bromide per 1,000 cu. ft. for periods of 3 hours at 60°F. or 3½ hours at 57°F., in addition to the schedules already noticed [**28** 610 ; **29** 499]. Administrative Instructions (B.E.P.Q. 499 supplement no. 3) authorise the treatment with lead arsenate by a method already described of potting soil, soil in and around cold frames and plunging beds, etc. [**28** 89] and plants before digging [**28** 90] at the rate of 26 lb. per 1,000 sq. ft., or 1,100 lb. per acre. Subsequent re-treatment will not be required where the concentration of lead arsenate in the soil as determined by chemical analysis is not less than 1,000 lb. per acre.

Hadley (C. H.). **The Japanese Beetle and its Control.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1856, 22 pp., 2 pls. (1 col.), 15 figs., 4 refs. Washington, D.C., 1940. [Recd. 1941.]

Descriptions are given of the appearance of all stages and the life-history of *Popillia japonica,* Newm., which was accidentally introduced into the United States at some time before 1916, and its distribution there in 1939 is shown on a map. The feeding habits of the adult and larva are described, and lists are given of the commoner trees and

plants that are and are not attacked by the former. The influence exerted by the climate [*cf.* *R.A.E.*, A **28** 17] and by predators native to the United States on the abundance of this Rutelid, and attempts in progress to control the larvae by means of the bacteria that cause milky disease [*cf.* **29** 369] and of parasites introduced from Japan and Korea are summarised. The control measures generally employed against the adults comprise the use of plants unattractive to them, hand collecting, and the use of traps [*cf.* **29** 125, 126] and contact and repellent sprays ; instructions are given for the preparation and use of the traps and sprays, and for treating turf and soil with lead arsenate to control the larvae.

GARDNER (T. R.) & PARKER (L. B.). **Investigations of the Parasites of *Popillia japonica* and related Scarabaeidae in the Far East from 1929 to 1933, inclusive.**—*Tech. Bull. U.S. Dep. Agric.* no. 738, 36 pp., 1 fig., 21 refs. Washington, D.C., 1940. [Recd. 1941.]

The following is largely based on the authors' summary of this account of the results obtained in further investigations on the parasites of *Popillia japonica*, Newm., and related Lamellicorns in Japan, Korea, India and Formosa during the period 1929–33 and their introduction into the United States [*cf.* *R.A.E.*, A **15** 297 ; **22** 72].

Four Tachinids and an Ortalid that parasitise the adults and two Tachinids and five Scoliids that parasitise the larvae of *Popillia* spp. were dealt with. Of the Tachinids that attack the adults, *Centeter cinerea*, Aldr., the most effective parasite of *P. japonica* in northern Japan, was found to be well distributed in Hokkaido, where it effects a high rate of parasitism each year. In Honshu, it was most abundant in the hilly and mountainous sections of the north and west, although its abundance in different localities was distinctly variable and the degree of parasitism was considerably lower than in Hokkaido. It was also found in the mountainous section of Kyushu. Between 1929 and 1933, 33,663 puparia were reared and shipped to the United States. *Hamaxia incongrua*, Wlk., which occurs generally throughout the Orient, was found in many further localities on the islands of Honshu, Shikoku and Kyushu in Japan, but the general rate of parasitism of *P. japonica* in the field was low and variable. *Trophops clauseni*, Aldr., was found in several new localities in western Japan, but the percentage parasitism in *P. japonica* was very low. *H. incongrua* and *T. clauseni* have two or more generations a year in Japan and are present in the field as adults over a longer period than the adults of *P. japonica*, and so require alternative hosts. No further records of *Eutrixopsis javana*, Tns., as a parasite of *P. japonica* were obtained. The percentage parasitism of the adults of other species of *Popillia* in India by *Adapsilia flaviseta*, Aldr., continued to be low in the field. In 1929, 3,800 puparia of this Ortalid were reared and shipped to the United States. Considerable rearing work was carried out with the Tachinids, *Prosena siberita*, F., which parasitises the larvae of *P. japonica* in Japan, and *Dexia ventralis*, Aldr., which attacks those of other species of *Popillia* in Korea ; 48,900 larvae were parasitised in the laboratory by these two species and shipped to the United States.

Investigations were carried out with five species of *Tiphia* parasitic on the larvae of *Popillia* spp. *T. popilliavora*, Rohw., and apparently

T. vernalis, Rohw., attack *P. japonica* in Japan and also occur in Korea; *T. matura*, A. & J., and *T. pullivora*, A. & J., were found only in India, and an unidentified species occurred in Formosa. The presence of these Scoliids in abundance in the field was always localised, sometimes changing from year to year, and apparently depended on a sufficient supply of adult food and suitable host larvae. Extensive rearing work was carried out with these species of *Tiphia*, and a total of 37,538 cocoons was shipped during the period. In addition, 47,815 adult females of *T. vernalis* were collected in the field and shipped; about 84 per cent. of these reached the United States alive. It was found that the adults from shipments of *T. pullivora* did not emerge at a time suitable for use against *P. japonica* in the United States, and their shipment was discontinued.

Investigations were also carried out on parasites for introduction into the United States against *Anomala orientalis*, Waterh., *Aserica* (*Autoserica*) *castanea*, Arr., and *Serica peregrina*, Chapin. *S. peregrina* [which was described in 1938 from Long Island, New York] had previously been recorded from the United States as *S. similis*, Lewis [**17** 444; **18** 640; **22** 73; **23** 379]. It is known to occur in Japan, Korea and China, but in the United States it has not apparently spread beyond New York. It has only one generation a year in Japan, the adults being present in the field from late June to late August. Although this Melolonthid is not considered a pest of major importance in Japan and Korea, the adults are reported to feed at times on a variety of cultivated plants there. No suitable parasites of the adults of these three Lamellicorns were discovered. Many species of *Tiphia* were found parasitising the larvae of species of *Anomala*, *Aserica castanea* and unidentified species of *Serica*, but only eleven were considered of sufficient importance to merit introduction. Of these, *T. tegitiplaga*, A. & J., and *T. biseculata*, A. & J., the hosts of which include *Anomala orientalis*, and *T. burrelli*, Parker, which attacks other species of *Anomala*, are recorded only from Japan, whereas *T. notopolita alleni*, Roberts, which parasitises several species of *Anomala* (including *A. orientalis* in Japan) occurs also in Korea and China. Of the parasites of *Serica*, *T. castaneaevora*, Parker, and *T. isolata*, Parker, which also attack *Aserica castanea*, and *T. sternata*, Parker, are recorded from Japan, *T. homoncularis*, Parker, which also attacks *A. castanea*, from Japan and Korea, *T. asericae*, A. & J., from Japan, Korea and China, and *T. satoi*, Parker, from Korea. Of all the species of *Tiphia* studied in Japan and Korea, only *T. biseculata* and *T. tegitiplaga* have two generations a year. Like the species that parasitise *Popillia*, they are very localised, and their effectiveness and distribution depend on a sufficient supply of adult food and suitable host larvae. Shipments of these eleven species between 1929 and 1933 totalled 6,139 females and 77,270 reared cocoons.

Entomology.—*Bull. Ohio agric. Exp. Sta.* no. 600 (Rep. 1937–38) pp. 26–34, 5 figs. Wooster, Ohio, 1939. [Recd. 1941.]

In comparative investigations in 1937 on the damage to the roots of 13 inbred strains of maize in Ohio by larvae of *Diabrotica duodecimpunctata*, F., pronounced differences in susceptibility to a heavy infestation were observed. Infestation of peach by *Cydia* (*Grapholitha*) *molesta*, Busck, in 1938 was one of the lowest on record in the State, and

this reduction appears to be due chiefly to parasites of the larvae. The percentage parasitism of twig-feeding larvae was high and ranged up to 90 in several collections during June and July. This may have been partly due to the mild winter of 1937–38, which probably permitted greater numbers of parasites to hibernate successfully. More parasites of the larvae were released in 1938 than in any previous year, approximately 19,000 individuals representing four species being liberated at 76 places in 25 counties. *Macrocentrus ancylivorus*, Rohw., is the most effective parasite in Ohio [*cf. R.A.E.*, A **26** 399 ; **28** 92].

Damage to the trunks of apple by *Saperda candida*, F., is mainly local in character in Ohio, owing to the erratic distribution of the wild food-plants of this Lamiid. Old and neglected orchards also provide breeding places, and young apple trees should be watched carefully until they are at least 12 years old if planted near such sources of infestation. The adults emerge from the trunks in May and June, and the females deposit their eggs in slits in the bark at the base of the tree, and occasionally in crotches, in June–August. The larvae hatch in 2–3 weeks. Investigations carried out over four years showed that all the paints, waxes, emulsions and adhesive preparations applied, alone or in combination with toxic materials, to the base of the trees to prevent oviposition were ineffective, while adhesives injured the bark. Wrapping the base of the trunk with cloth or paper prevented oviposition, and newspaper was as effective as any other material for this purpose [*cf.* **26** 399]. The most practical measure for orchards in which less than 20 per cent. of the trees are infested is still to mound the trees with clean earth, so that the eggs are laid higher on the trunk and the resulting larvae are more easily cut out.

Five years work on the control of *Empoasca fabae*, Harr., on potato, has shown that the best material is a spray of Bordeaux mixture [*cf.* **28** 92], which prevents hopperburn, reduces the leafhopper population by over 90 per cent. and increases the average yield by over 70 per cent., as compared with untreated controls. The best formula was 5 lb. copper sulphate, 2½ lb. lime and 50 U.S. gals. water. A freshly mixed dust of copper sulphate and lime (20 : 80) gave equally satisfactory results, but must be applied when the plants are wet with dew. Fine dusting sulphur gave excellent control of the Jassid, but the yield of tubers was slightly lower than that following the use of Bordeaux mixture. Experiments on the timing of sprays showed that they should be applied as soon as the plants are well above the ground, and before injury is apparent. Failure to apply the first two sprays at the correct time decreased the yield by 22 per cent. The first four applications should be made at weekly intervals to provide maximum protection to the foliage, but after the middle of the growing period the interval may safely be increased to 10–14 days.

In tests of insecticides in dusts for the control of *Pieris* (*Ascia*) *rapae*, L., *Plusia* (*Autographa*) *brassicae*, Riley, and *Plutella maculipennis*, Curt., on cabbage, the percentages of heads free from injury at harvest were 67 for Paris green, 64 for lead arsenate, 23 for derris powder, 8 for zinc arsenite, and 6 for pyrethrum powder and dusts impregnated with pyrethrum extract. Chemical analysis showed that the arsenical residue was negligible on cabbage cut to U.S. No. 1 grade ; when the cabbage was cut 20 days after the last application, almost all the arsenic that remained was on the four wrapper leaves.

Light-traps were used in 1938 to test the response to light of adults of the three tomato pests, *Heliothis armigera*, Hb. (*obsoleta*, F.), *Cirphis unipuncta*, Haw., and *Protoparce sexta*, Joh. To obtain a wide range in the intensity and quality of the light, the lamps used were a 60-watt CX lamp, a 15-watt blue fluorescent lumiline lamp, a type H-4 mercury vapour lamp, a type S-4 mercury vapour lamp, and two Mazda lamps, 100 watt and 150 watt. The catches indicated a very sparse population of *H. armigera* in June and a gradual increase during the season, 25 moths being captured nightly in June and as many as 30 per night in August. From June to 12th September 22 adults of this species came to the two Mazda lamps, 35 to the blue fluorescent, 97 to the H-4, and 131 to the S-4 lamp. The numbers of adults of *C. unipuncta* and *P. sexta* caught over a period of two months were 136 and 3 at the blue fluorescent lamp, 516 and 82 at the H-4 lamp and 731 and 192 at the S-4 lamp.

Slate (G. L.), Suit (R. F.) & Mundinger (F. G.). **Raspberry Growing in New York: Culture, Diseases, and Insects.**—*Circ. N. Y. agric. Exp. Sta.* no. 153, 57 pp., 12 figs. Geneva, N.Y., 1940. [Recd. 1941.]

In the section on virus diseases, two mosaics of raspberry, designated green mosaic and yellow mosaic, and two leaf-curls are recognised [*cf. R.A.E.*, A **15** 598; **22** 175, etc.]. The mosaics are common in both wild and cultivated red raspberries [*Rubus strigosus*] and are difficult to distinguish in them; green mosaic is the more common in black raspberries [*R. occidentalis*] and purple raspberries [*R. strigosus* × *occidentalis*] and can be distinguished in them from yellow mosaic relatively easily. Both mosaics are carried almost exclusively by the large raspberry Aphid [*Amphorophora rubi*, Kalt.], which causes no noticeable injury to the plant [*cf.* **22** 176]. Losses can be avoided by growing resistant varieties, isolating new plantings, eradicating wild host plants and roguing the beds. The leaf-curl diseases occur throughout most of New York State, but are not common. One of them affects only red raspberries, whereas the other may also occur in black varieties; purple raspberries may be considered immune from leaf-curls. The viruses are transmitted by the small raspberry Aphid [*Aphis rubicola*, Oestl. (*rubiphila*, Patch)] and are readily controlled by inspection and roguing [*cf.* **15** 598].

The importance of the Arthropod pests that attack raspberry in New York State appears to vary with the season and locality, but, in general, *Byturus unicolor*, Say, and *Tetranychus telarius*, L., were more injurious than any others during 1935–40. *B. unicolor* attacks purple and red raspberries, particularly early varieties of the latter. The adults emerge in early May and feed first on the buds and young leaves of fruiting shoots and later on the flower buds, sometimes preventing the development of fruit. The eggs are laid on or near the blossom clusters or on the green fruit. On hatching, the larvae enter the blossom or fruit, where they feed on the fleshy receptacles; when full grown, they drop to the ground and burrow under the surface to pupate. The autumn and winter are passed in the pupal stage. Infestation is usually first detected at picking time, when the larvae are found in the berries. Control measures comprise shallow cultivation of the soil close to the plants in autumn to destroy the pupae and, if necessary, two applications of a spray of 4 lb. lead arsenate and 1 lb.

casein spreader or powdered skim milk in 100 U.S. gals. water to kill the ovipositing females, the first when the blossom clusters are forming and the second ten days later as the blossoms begin to open.

T. telarius is usually most prevalent during hot, dry seasons. Oviposition and feeding occur on the lower surfaces of the leaves. Foliage injury appears first on the fruiting canes and later on the new growth, reducing the fruit production in both the current and the following season. The severity of the damage is reduced by cultural practices that promote and sustain rapid growth of the plants, and excellent control is obtained by a spray of 1 gal. white-oil emulsion per 100 gals. water, which kills all stages of the mite and can be applied at any time when the population becomes heavy. Where infestation has been serious for several years, an application about 2–3 weeks before harvest each year is advisable ; if it is very heavy, two further applications at intervals of 5–7 days may be necessary, but repeated oil sprays have caused some scorching of the leaves in western New York. *Blennocampa* (*Monophadnoides*) *rubi*, Harr., is sometimes a serious pest of red raspberries, and also attacks blackberries and dewberries. The adults of this Tenthredinid appear early in May, and the eggs are laid singly in the leaves. The larvae feed mainly on the leaves, but occasionally on the new bark, the blossom buds or the young fruit. A spray of 3 lb. lead arsenate in 100 U.S. gals. water should be applied if infestations appear early in the season, and pyrethrum or derris sprays against those that develop after the fruit is set.

The adults of the Lamiid, *Oberea bimaculata*, Ol., usually appear in June ; the female girdles a new cane completely near the tip with two rows of punctures and oviposits in the pith between them. The punctures cause the cane to wilt and die ; the young larva burrows to the base of the cane, from which the adult emerges in the spring of the following year. Canes that show injury during the summer should be cut off several inches below the girdled portion and destroyed, and all infested canes should be cut out and burnt between late autumn and early spring ; where old fruiting canes are pruned and burnt each year, *O. bimaculata* causes little injury. Wild raspberries, in which the borers breed, should be eliminated from the neighbourhood of cultivated plants. The adults of the Buprestid, *Agrilus ruficollis*, F., which forms irregular swellings 1–3 inches long on the new canes of raspberries, blackberries and dewberries, killing or weakening the canes, are present in the field most of the summer ; the females deposit their eggs singly on the bark. The larva first feeds in the sapwood of the bark and later enters the pith, where it overwinters ; it completes its development and pupates in the following spring. Infested canes should be cut out and burnt while dormant, and wild canes should be destroyed.

The tree cricket, *Oecanthus nigricornis*, Wlk., is present in the nymphal or adult stage during most of the summer, but is not usually sufficiently abundant or injurious in raspberry plantings in western New York to require special control measures, particularly if the new canes are pruned each season and the prunings are burnt. The damage results from the rows of egg punctures along the cane. They are usually found within a foot or two of the tip, and tend to cause the canes to split or break off ; if they occur on the lower portion of the plant, the cane may become weakened, and normal development of the fruit in the following season be prevented. *Hylemyia* (*Phorbia*) *rubivora*, Coq., is seldom a serious pest on raspberry. The larva burrows in the pith

and later girdles the shoot, causing the part above to wilt and die. Infested shoots should be cut off several inches below the part attacked and burnt. White grubs [larvae of *Lachnosterna* spp.], which are frequently numerous on land that has been under grass for several years, sometimes attack the roots of raspberry. Heavily infested land should not be planted with raspberries, and newly broken sod should be planted for at least one year with a crop less subject to injury.

HANSON (E. W.) & MILLIRON (H. E.). **The Relation of the Curculionid,** *Anacentrinus deplanatus*, **to Root Rot and Basal Stem Rot of Barnyard Grass,** *Echinochloa crusgalli*.—*Phytopathology* **31** no. 9 pp. 832–837, 3 figs., 5 refs. Lancaster, Pa., 1941.

In view of the possibility that insect attack on the lower parts of the plants favours the development of root rot and basal stem rot of cereals and grasses, investigations were carried out in Minnesota on the part played in this respect by *Anacentrinus deplanatus*, Csy., which infests barnyard grass (*Echinochloa crusgalli*), has been recorded from sugar-cane in Louisiana [*cf.* *R.A.E.*, A **20** 589] and possibly attacks other plants. The larva, pupa and adult of this weevil are briefly described. Near St. Paul, the larvae occur in the culms of *E. crusgalli* from June to September. There is usually only one per culm, and they pupate in chambers within the plants. The adults emerge in autumn.

In the investigations described, 500 infested and 500 uninfested plants of *E. crusgalli* collected at random were surface-sterilized, and plate cultures were made. Many kinds of soil fungi and bacteria were found associated with root rot and basal stem rot, and the amount and severity of the decay was consistently greater in the plants infested by the weevil, which not only wounds the plant, weakening it and furnishing avenues of invasion for the fungi and bacteria, but also deposits frass in the tunnels, which facilitates the development of these organisms. Once the organisms become established, they can spread into the adjacent uninfested tissue. Larvae, pupae and adults were found to have all these fungi and bacteria on the exterior parts of their bodies, and some of them also in the body contents.

ZELLER (S. M.) & WEAVER (L. E.). **Stunt Disease of Strawberry.**—*Phytopathology* **31** no. 9 pp. 849–851, 1 fig., 3 refs. Lancaster, Pa., 1941.

A description is given of the symptoms of a disease of strawberry that occurs in western Washington and in two valleys in Oregon and is caused by a virus for which the names *Fragaria* virus 5 and *Nanus cupuliformans* are here proposed. It causes stunting of the plants and cupping of the leaves, but little reduction of chlorophyll. Injury is most severe under the cooler, more humid conditions that prevail in the coastal region. Affected plants give light yields of small and inferior fruit. In experiments, the virus was transmitted by the Aphid, *Capitophorus fragaefolii*, Ckll., from diseased to healthy plants of the Marshall variety and from certain crosses to the Marshall variety. Evidence was obtained in one case of a double infection of stunt and

crinkle ; the symptoms of the latter were completely masked and those of stunt abnormal, giving a result somewhat similar to that produced by the Tarsonemid mite [*Tarsonemus pallidus*, Banks].

Sokoloff (V. P.) & Klotz (L. J.). **Mortality of the Red Scale on Lemons through Infection with a Spore-forming Bacterium.** (Abstract.)—*Phytopathology* **31** no. 9 p. 864. Lancaster, Pa., 1941.

Experiments with some 7,000 adult females of *Aonidiella aurantii*, Mask., showed that under optimum laboratory conditions complete mortality was given by dusting or spraying the Coccids with spores of a denitrifying bacterium isolated from the soil and tentatively designated as Bacillus " C." Complete mortality was also given by immersion.

Production of gas, distortion of the pygidia and a characteristic browning of the insects often appeared to be symptoms of infection, followed by disintegration and drying. Extracts of infected insects showed a loss of nitrate. The bacterium is aerobic, but can grow anaerobically in the presence of nitrate or nitrite on certain organic substances, including chitin.

Dowden (P. B.). **Parasites of the Birch Leaf-mining Sawfly** (*Phyllotoma nemorata*).—*Tech. Bull. U. S. Dep. Agric.* no. 757, 55 pp., 26 figs., 27 refs. Washington, D.C., 1941.

The following is largely based on the author's summary. The birch leaf-mining sawfly, *Phyllotoma nemorata*, Fall., became abundant in Maine in 1926 and is still numerous in a number of areas. It has one generation a year and overwinters as a prepupa within a lens-shaped hibernaculum, spun inside the larval mine between the end of August and the beginning of October. At Bar Harbor, pupation takes place in June and July, and the adults emerge about nine days later, chiefly during the last ten days of June. No males have been observed. Oviposition begins soon after emergence and lasts about a week. The eggs are inserted in the leaf tissue between the upper and lower surfaces of the leaf tooth and hatch in about 19 days. Several indigenous parasites were reared in Maine. *Trichogramma minutum*, Riley, was the most important egg parasite, and *Gelis urbanus*, Brues, *Spilocryptus* (*Agrothereutes*) *slossonae*, Cushm., *Pimpla* (*Epiurus*) *indagatrix*, Cress., and *Alophosternum foliicola*, Cushm., were the species most commonly reared from hibernacula and larvae. The degree of parasitism varied considerably and was negligible in many collections. Collections made throughout the year indicated that parasitism of the prepupae in spring by *Gelis* and *Spilocryptus* constituted the most important parasitic check on the sawfly in Maine. At times, birds are of importance as predators [*cf. R.A.E.*, A **22** 396].

Although *P. nemorata* is present in many European countries, no severe infestation has ever been reported in them. From 1930 to 1934, *Phyllotoma* material was collected in Austria and southern Bohemia in order to obtain parasites for liberation in the United States. It was found that birds gave the most effective control, parasitism being generally low ; in some localities small larvae were heavily parasitised, but very few parasites were reared from the hibernacula. About 20 species of parasites were reared, but many of them act as both primary, and secondary parasites, and consequently only the Eulophids, *Chrysocharis laricinellae*, Ratz., and *Chrysocharis* sp.,

the Braconid, *Phanomeris phyllotomae*, Mues., and the Ichneumonids, *Pimpla* (*Epiurus*) *foliae*, Cushm., and *Tranosema pedellum*, Hlmgr., were liberated in the United States. Of these, *C. laricinellae* and *P. phyllotomae* have become established and have been recovered from *Phyllotoma* in small numbers at several liberation points, the former in Maine and New Hampshire and the latter in Maine. These two species together represented about 72 per cent. of the parasites reared. *C. laricinellae* was also introduced from Europe as a parasite of *Coleophora laricella*, Hb., and has been recovered from this host in Maine, New Hampshire, Vermont and New York. Moreover, it was reared in the course of these investigations from *Fenusa ulmi*, Sund., on elm in Massachusetts and Vermont and may have been introduced into the United States with this sawfly many years ago.

The biology and immature stages of twelve of the parasites obtained were studied in detail. *Phanomeris phyllotomae* develops as an external parasite of the *Phyllotoma* larvae and has one generation a year. *Pimpla foliae* oviposits in the hibernacula, and its larvae feed externally on the prepupae of the host. The females of *Spilocryptus* (*Agrothereutes*) *pygoleucus*, Grav., are subapterous and oviposit on or near the hibernating prepupae. This species was not liberated as it sometimes attacks the cocoons of primary parasites. Females of *Tranosema pedellum* oviposit in very small host larvae, and the parasite overwinters in the first larval instar in the prepupa of the host and emerges in the spring. This species seems to be poorly adapted to *Phyllotoma*, for many eggs and larvae die without completing development. Eight species of Eulophids were reared. *Chrysocharis laricinellae*, which was the most important parasite of *Phyllotoma* in Europe, is a solitary internal parasite of small larvae. The other species of *Chrysocharis* is a gregarious internal parasite that completes its development in large larvae. *Hemiptarsenus anementus*, Wlk., is a gregarious external parasite, attacking prepupae that have spun their hibernacula. The stock of this species died out before it could be ascertained whether it might also be a secondary parasite. *Sympiesis* sp., *Pnigalio cruciatus*, Ratz., *Cirrospilus pictus*, Nees, *C. vittatus*, Wlk., and *Tetrastichus xanthops*, Ratz., are all external parasites of partly grown larvae, but all of them sometimes develop as hyperparasites and they were therefore not liberated. *C. pictus* and *T. xanthops*, however, already occur in the United States ; the former was reared from *P. nemorata* in Maine in 1937 and had been reared from *Fenusa pusilla*, Lep., in Quebec in 1930, while the latter was obtained from mines of *F. ulmi* in Massachusetts.

The remainder of the parasites, which included *Pimpla* (*Epiurus*) *brevicornis*, Grav., another species, possibly *P.* (*E.*) *buolianae*, Htg., *Mesoleius phyllotomae*, Cushm., a species of *Closterocerus*, possibly *C. sesquifasciatus*, Ratz., and some undetermined Chalcidoids, were obtained only irregularly and in very small numbers. Laboratory rearing of *Phyllotoma* parasites was difficult, as the host is a leaf-miner that develops very slowly. Various methods of rearing were used, and many of the Chalcidoid parasites were reared on *Fenusa ulmi*.

HOVEY (C. L.). **Studies on** *Chion cinctus* (**Drury**) (**Coleoptera, Cerambycidae**) **in Oklohoma.**—*Proc. Okla. Acad. Sci.* **21** pp. 23–24. Guthrie, Okla., 1941.

An account is given of investigations in Oklahoma from October 1938 to June 1939 on the bionomics of the Cerambycid, *Chion cinctus*,

Drury, which attacks diseased or otherwise weakened trees, including plum, walnut, apple, pecan and particularly hickory. The latter, however, is not common in Oklahoma and the chief injury is to pecan. From branches of pecan infested by larvae in various stages of development and caged in the laboratory in early spring, the adults emerged from 19th April to 13th June. Males survived for 9–19 days and females for 14–25. The beetles were placed in oviposition cages, and eggs were observed 3–10 days later in cracks in the bark of the cuttings in the cages. Females laid 8–33 eggs. The larvae hatched in 7–9 days and some of them fed for a time in the sapwood, while others tunnelled directly into the heartwood. The duration of the larval stage was not ascertained, as it was longer than the period of observation. Pupation occurred at the end of the galleries.

FENTON (F. A.). **The Insect Pest Record for Oklahoma 1940.**—*Proc. Okla. Acad. Sci.* **21** pp. 25–28. Guthrie, Okla., 1941.

Records are given of insects of economic importance, chiefly pests of various crops, that were observed in Oklahoma in 1940. Infestation of cereals by *Blissus leucopterus*, Say, was the most severe since 1933 and was particularly serious in north-eastern Oklahoma. As a result of delayed emergence from hibernation quarters due to an early cool spell, some early maize was attacked by bugs emerging directly from hibernation. C. F. Stiles reported that 16,916 U.S. gals. creosote were used in barriers to protect 15,500 acres. Where no barriers were used, the migrating bugs caused damage to 33,703 acres, with an estimated loss of $77,582. On account of a warm, late autumn, the bugs entered hibernation later than usual, after attacking winter wheat in October. *Chlorochroa sayi*, Stål, was injurious to wheat in two counties and damaged late planted wheat in one of them. Heavy infestations of the grasshoppers, *Melanoplus mexicanus*, Sauss., and *Aiolopus turnbulli*, Caud., of which the former was the more injurious, also occurred in this county and in one other.

HUCKETT (H. C.). **Non-arsenical Dusts for Cauliflower and Cabbage Worm Control on Long Island.**—*Bull. N. Y. agric. Exp. Sta.* no. 695, 58 pp., 10 refs. Geneva, N.Y., 1940. [Recd. December 1941.]

A summarised account is given of experiments carried out during 1933–38 on Long Island, New York, on the use of non-arsenical dusts for the control of *Pieris rapae*, L., *Plusia* (*Autographa*) *brassicae*, Ril., *Plutella maculipennis*, Curt., and *Ceramica* (*Mamestra*) *picta*, Harr., on cauliflower, cabbage and brussels sprouts, the main results of which have been noticed from previous reports [*R.A.E.*, A **28** 427, etc.]. Pyrethrum dusts were generally easier to apply successfully than impregnated pyrethrin dusts ; the use of clay as a diluent conferred superior dusting qualities on the mixtures, but reduced the toxicity of the impregnated dusts [*cf.* **25** 550] and also that of the pyrethrum dusts when it represented more than one half of the prepared mixture. Mixtures of diatomaceous earth and either pyrethrum or an impregnated pyrethrin dust gave satisfactory control, but their practical use is seriously restricted by the fact that most types of dusters for vegetable crops are not adapted to dealing with such bulky mixtures. The most satisfactory diluent in these dusts was talc.

Luginbill (P.). **The Southern Corn Rootworm and Farm Practices to control it.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 950, 10 pp., 9 figs. Washington, D.C., 1940. [Recd. December 1941.]

A brief account is given of the economic importance, distribution and bionomics as a maize pest of *Diabrotica duodecimpunctata*, F., the larvae of which cause serious injury to this crop in the southern United States. Lowland maize suffers the most severely, and injury is greatest during cool, damp seasons. The larvae of this Galerucid feed on the roots and, in young maize, bore into the crown, killing the bud and often causing the plant to break off at the point of injury. Infested plants either die or are too stunted to be productive. The larvae also attack other cereals, grasses and lucerne, while the adults sometimes damage young maize by cutting off the bud leaves, though they feed chiefly on cucurbits.

The adults overwinter, except on the northern margin of their area of distribution, where they die at the end of each season, the area being reinfested annually by migrant beetles from the south. There are two complete generations a year near Columbia (South Carolina), but second-generation adults do not oviposit until the following spring. The incubation period lasts about 3 weeks in early spring and 6–8 days in mid-summer ; the larval stage is completed in 3–6 weeks, usually 3–4 ; and the pupal stage lasts 6–8 days in summer and 10–13 days in spring and autumn. The adults are parasitised by the Tachinid, *Celatoria diabroticae*, Shim., which, however, is not very common.

Investigations in the lowlands of the south-eastern United States have shown that maize planted late enough escapes severe injury and planting dates based on them are therefore recommended for three subdivisions of the infested area. Lowlands should be ploughed at least a month before planting, and the amount of seed used per acre should be twice as great as on the uplands. Where damage is severe, profusely rooting hybrid varieties of maize should be used. Leguminous crops should be included in the rotation to provide humus and nitrogen [but *cf. R.A.E.*, A **24** 468], and commercial fertilisers should be used instead of animal manure, which promotes infestation. Weeds and rubbish that might form suitable hibernating quarters for the adults should be burnt.

Phillips (W. J.) & Poos (F. W.). **The Wheat Jointworm and its Control.**—*Fmrs' Bull. U. S. Dep. Agric.* no. 1006 revd., 12 pp., 17 figs. Washington, D.C., 1940. [Recd. December 1941.]

The distribution of *Harmolita tritici*, Fitch, which attacks wheat in the eastern and parts of some of the western United States, and is an important pest in most of the wheat States east of the Mississippi and in parts of Missouri, Utah and Oregon is shown on a map, and all stages are briefly described. Infested stalks are distinguished by the presence of woody galls, which are not always visible externally and which contain larvae, immediately above the second or third joint. Infestation by the Hessian fly [*Mayetiola destructor*, Say] also causes the stalks to fall, but the larvae do not occur in galls. The heads of stalks broken as a result of infestation by *H. tritici* are often lost during harvest, while the grains from infested stalks, whether broken or not, are lighter in weight and smaller than those from uninfested stalks. Strong, vigorous plants are less severely injured.

There is one generation a year. Oviposition occurs in April and May, shortly after the emergence of the adults, and as many as 18 eggs may be deposited above a single joint ; each female lays 70 eggs or more. The larvae hatch in about 12 days and feed in cells in the stem ; when several cells (generally 8) occur together, the stem becomes hard and woody, forming a gall. Since most of the galls are at the lowest joint of the stalk, the majority of the larvae remain in the stubble after harvest, and where, as in most of the infested area, clover or grass is sown with the wheat and the stubble consequently left undisturbed for a year, ideal conditions for development are provided. By November or December, about 90 per cent. of the larvae have pupated within the cells ; both larvae and pupae overwinter. On emerging from the stubble in spring, the adults migrate to growing wheat. Their powers of flight are weak, but they may be carried considerable distances by the wind, which is the chief agent of dispersal.

Mortality of overwintering larvae and pupae is sometimes high, especially in wet cold winters. The larvae are parasitised by *Ditropinotus aureoviridis*, Crwf., *Eupelmus allyni*, French, and *Eurytoma parva*, Phillips. *D. aureoviridis* has two generations and a partial third each year in central Virginia, and the females oviposit in the cells containing the host larvae. This Torymid overwinters in the larval stage in the cells, and the adults emerge in spring when the host larvae in the new wheat are already well-developed. The life-history of *Eupelmus allyni* is similar, but it has four or more generations a year. Eggs of *Eurytoma parva* are deposited when the larvae of *H. tritici* are about one-fifth grown ; on hatching, the parasite larvae attack the host larvae, but complete their development on the plant tissues. There is one generation a year, and the larvae overwinter in the stubble.

In areas heavily infested by *H. tritici*, it is important that control measures should be applied throughout the whole district. The wheat should be cut as high as possible so that the larvae are left in the stubble, which should be ploughed under deeply soon after harvest ; where soil conservation is of importance, soy beans, sweet clover [*Melilotus*] and other fodder or green manure crops should temporarily be substituted for red clover. In addition, wheat should be sown as far as possible from standing stubble of the previous year, and only manure containing straw that has been well-rotted or thoroughly trampled, thus destroying overwintering larvae or pupae, should be used as top-dressing for wheat. In districts where losses due to *H. tritici* are serious, the substitution of rye, barley, oats or buckwheat for wheat is recommended. Rye is the most suitable substitute in winter-wheat areas, and it is not often severely injured by *M. destructor* and other insect pests of wheat.

Cowan (F. T.) & Shipman (H. J.). **Control of the Mormon Cricket by the Use of Poisoned Bait.**—*Circ. U.S. Dep. Agric.* no. 575, 15 pp., 3 figs., 3 refs. Washington, D.C., 1940. [Recd. December 1941.]

The following is based on the authors' summary. Dusting with sodium arsenite has since 1927 been the basic method of controlling *Anabrus simplex*, Hald., in the United States, but owing to various objectionable features in this method, attempts were made in 1935–39 to develop a satisfactory bait for the control of this Tettigoniid. In

the earliest tests, the insects were caught and confined in large enclosures in which they were given the poisoned bait, but this did not give them enough choice of food, and in tests in and after 1937 the bait was scattered in front of converging sheet-metal barriers and between them, and the insects were given 20–60 minutes to feed or move forward into a chute that led them to an observation pen or to a cage from which they were transferred to the pen. If too few had moved forward at the end of an hour, those between the barriers were driven into the chute. Tests carried out in 1935–37 showed that standard bran was the best carrier, and that sawdust mixed with mill-run bran, flour or shorts was more effective than cracked wheat or dried beet pulp ; that various attractants added to a bait of sodium arsenite, bran and water did not increase its efficiency ; and that a bait containing 4 lb. sodium fluosilicate and 2 U.S. gals. black oil distillate per 100 lb. bran was more effective than one containing 2 U.S. quarts sodium arsenite (32 per cent. As_2O_3). These results were confirmed in more detailed experiments in 1938–39, which proved conclusively that effective and economical control of both nymphs and adults could be obtained by the proper use of sodium fluosilicate bait with standard bran, or, under conditions of high temperature and little soil moisture, with mill-run bran and sawdust as the carrier. There was no significant difference between the mortality obtained with baits containing molasses, black distillate or no attractant, and sodium arsenite was repellent even at rates as low as ½ U.S. pint per 100 lb. bran. It was found that 2 lb. sodium fluosilicate per 100 lb. bran was more effective than 2 U.S. quarts sodium arsenite, but less effective than 4 lb. sodium fluosilicate, whereas 3 lb. sodium fluosilicate was as effective as 4 lb. against both nymphs and adults. This material and sodium fluoride were more effective than synthetic cryolite or calcium fluoride. According to these tests, crude arsenic at the rate of 4 lb. per 100 lb. bran is not distasteful to the adults and might be substituted for the sodium fluosilicate, but it increases the danger to livestock. Standard bran was again shown to be the best carrier, although in large-scale tests in South Dakota and Wyoming, high mortalities were obtained with a bait containing mill-run bran and sawdust (1 : 3). Observations of the numbers of insects feeding on the baits at different times of the day, carried out in 1938 on adults and in 1939 on nymphs, showed that feeding is so closely correlated with migration that it is possible to recommend that the bait should be spread only during migrations [*cf. R.A.E.*, A **29** 428].

CHAMBERLIN (W. J.). **The Bark and Timber Beetles of North America north of Mexico. The Taxonomy, Biology and Control of 575 Species belonging to 72 Genera of the Super Family Scolytoidea.**—$10\frac{3}{4} \times 8\frac{1}{2}''$, vi+513 pp., multigraph., 5 pls., 321 figs., many refs. Corvallis, Ore., O.S.C. Coop. Ass., 1939. [Recd. 1942.]

An attempt is made to co-ordinate the available information on the taxonomy and biology of the Scolytids and five species of *Platypus* that occur in North America north of Mexico and are responsible for 85–90 per cent. of the large annual loss of forest, shade and ornamental trees that is caused by insects.

The first part of the book (pp. 1–101) contains sections dealing with fossil and introduced species ; the distribution of the two families in the United States and Canada ; the various types of galleries

constructed by them ; bionomics and food-plants ; association with fungi and mites ; insect, Nematode and fungous parasites ; insect and other predators ; the effects of climate, fires, competition for food with Cerambycid larvae and the presence of slash on survival and numbers ; the ways in which the susceptibility of trees to attack varies with their condition ; and methods of control. The standard control measures are exposing felled trees or stripped bark to the heat of the sun, the destruction by burning of small infested trees, barking and burning infested trees, the use of trap trees, felling and sending to the timber mill as quickly as possible trees in a stand in which infestation appears, and holding logs in water until they can be sent to the mill. Newer, less expensive methods that show promise are the injection of chemicals into the sap stream to destroy the insects, the use of oil for scorching the bark of logs, and spraying the logs with oil, alone or mixed with other substances, to kill the brood.

The greater part of the book (pp. 102–465) deals with taxonomy, and includes information on the synonymy, distribution, food-plants, appearance and habits of the five Platypids and 570 Scolytids, together with keys.

Blackman (M. W.). **Bark Beetles of the Genus *Hylastes* Erichson in North America.**—*Misc. Publ. U.S. Dep. Agric.* no. 417, 27 pp. Washington, D.C., 1941.

This revision contains descriptions of all the species of *Hylastes* known to occur in Canada and the United States, including one new species from the former and six from the latter. A key to them is given. These bark-beetles are less important than those of certain other genera, as they seldom or never cause the death of healthy large conifers, though they are often found in the bark of dying pine or spruce. Newly emerged adults, however, often feed on the tender bark of young pine and spruce, and where a heavy beetle population occurs near a forest nursery or young plantation, they may kill many trees by girdling the bark or actually severing the stem at or below the root collar. Pines are the favoured food-plants of most species of *Hylastes*, but some spruces are also attacked, as well as Douglas fir (*Pseudotsuga taxifolia*) and to a less extent the true firs (*Abies* spp.).

Borchert (A.). **Ueber die *Acarapis*milbe sowie über das Problem ihrer Bekämpfung.** [The *Acarapis* Mite and the Problem of its Control.]—*Z. Parasitenk.* **12** pt. 1 pp. 86–93. Berlin, 1940. [Recd. 1942.]

Infestation of the tracheae of honey bees by *Acarapis* [*woodi*, Rennie] is common in parts of southern Germany and in Austria and is spreading to other districts. Cases of light infestation are extremely difficult to detect, and the available methods of control by fumigation have not proved entirely satisfactory. The fumigants commonly recommended are Frow's mixture [*R.A.E.*, A **20** 63, 144] and methyl salicylate (oil of wintergreen) [**20** 145], and in view of numerous reports of failure to obtain control with them, tests were carried out on the toxicity of these and other materials to the mite. They showed that complete mortality was given in 23 hours by atmospheres containing the fumes of methyl salicylate used at the rate of 4 volumes liquid per million, and that the control afforded by Frow's mixture was not

improved by varying the proportion of its constituents or delaying vaporisation by using containers of reduced surface area. When the safrol in the mixture was replaced by mustard oil [allyl isothiocyanate], which has been shown by H. Schulz to give complete mortality of the mite in 13½ hours at a rate of application of 0·03 volumes liquid per million, the bees were adversely affected, and mixtures of mustard oil with other fumigants also disturbed the bees. No control of the mite was given by feeding the bees for 5–6 days on a mixture of honey, water and a preparation containing antimony. Living mites were observed in bees up to 90 hours after the latter had been killed by the infestation.

Salt (G.). **The Effects of Hosts upon their Insect Parasites.**—*Biol. Rev.* **16** no. 4 pp. 239–264, 6 figs., 53 refs. Cambridge, 1941.

The following is substantially the author's summary. The size of many insect parasitoids is influenced by the size of the different species and individuals of host on which they develop [*cf. R.A.E.*, A **29** 340]. Through its effect on gross size, the host may influence the size and proportion of parts, the presence or absence of wings, the developmental period, the fecundity, the vigour and the behaviour of its insect parasite. In the case of one parasite, *Trichogramma semblidis*, Auriv., the fundamental dimorphism of the males is controlled by the species of host on which it develops, winged males being produced when it is reared on eggs of Lepidoptera, apterous males when it develops in eggs of *Sialis lutaria*, L. [*cf.* **26** 102]. The rate of development of many insect parasites is influenced by the host. In the most striking cases, the transfer of a state of diapause from the host to the parasite is involved [*cf.* **15** 653–654 ; **27** 80], and the host may determine how many generations the parasite may have in a year. Different species of hosts may cause individuals of a parasitic species to behave differently. The behaviour of the larval parasite may be affected, or that of the emerging adult, or that of the adult parasite seeking hosts for its own offspring. In view of these various effects of the host on the morphology, physiology and behaviour of its parasite, it is necessary to control and standardise the hosts used for any precise work in insect parasitology.

Kulagin (N. M.) & Pyatnitzkiĭ (G. K.). **Кулагин (Н. М.) и Пятницкий (Г. К.).** Ed. **The Beet Weevil and its Control.** [*In Russian.*]—Demy 8vo, 151 pp., 29 graphs, 18 figs., 2 refs. Moscow, Vsesoyuzn. Akad. s.-kh. Nauk Lenina, 1940. Price 6 *rub.* [Recd. December 1941.]

This is a collection of the more important reports read at a conference in Kiev in November 1938 on investigations in Russia on the bionomics and control of the beet weevil [*Cleonus punctiventris*, Germ.]. In addition to papers that are primarily of local interest, they include the following :

Pyatnitzkiĭ (G. K.). **Agrotechnical Methods of Controlling the Beet Weevil,** pp. 25–37. Investigations in 1937–38 showed that in the chief zones of its distribution, *C. punctiventris* occurs in spring in all the fields used in the crop rotation cycle, and is most abundant in those in which beet has been grown in one of the three preceding years. Its abundance in these fields is believed to be due to the presence of weeds

on which it can breed [*cf. R.A.E.*, A **24** 489; **26** 473] and to protracted dormancy in the soil [**28** 599; **29** 577]. The overwintered weevils begin to make their way up to the surface of the soil as soon as the soil temperature rises above 2°C. [35·6°F.], provided that the upper layers of the soil are warmer than those below, and this movement of the population continues more or less until the end of the summer when the temperature near the surface falls below that of the lower layers. The majority of weevils in a given year, however, reach the upper layers in early spring at soil temperatures of 2–6°C. [35·6–42·8°F.]. The rate of migration subsequently decreases, in spite of higher soil temperatures, and the weevils move upwards in small batches on warm days after spells of cold rainy weather. In spring, they sometimes remain in the upper layer of soil for fairly long periods, until they are stimulated to seek food by exhaustion of the fat-body, and probably also lack of moisture. They begin to leave the soil when the temperature at the surface reaches 15–18°C. [59–64·4°F.], most of them doing so at 25–30°C. [77–86°F.]. Observations showed that the weight of the weevils varies directly with the depth at which they occur; those kept without food in the laboratory lost weight owing to exhaustion of the fat-body, the loss being more pronounced as the temperature rose and the relative humidity decreased. The process is, however, very slow even at 35°C. [95°F.], and the weevils survive starvation for long periods. The percentage of weevils that overwinter a second or third time increases with the depth at which they occur, and in 1937 reached 90 at depths of 16–20 ins. After years in which cold weather begins early in autumn, the percentage of weevils that hibernate a second or third time in old beet fields increases markedly. Deep autumn ploughing reduces the population and somewhat accelerates emergence from the soil in spring. Dormancy and upward migration are also influenced by the amount of carbon dioxide in the soil [*cf.* **28** 599], which is least in January and greatest in July, is directly proportionate to the temperature, humidity and compactness of the soil, increases in the deeper layers, and falls sharply after ploughing.

In special experiments, loosening the soil between the rows of beet every two days from the beginning of the oviposition period reduced the weevil population by only 2–8 per cent. as compared with the control, but increased the yield of beet by 40 per cent. P. F. Mende and B. V. Romanevich have shown that mortality is high in soils that are poor in humus, the immature stages of the weevil being killed chiefly by the red muscardine fungus [*Tarichium uvella*] in soils that are more alkaline than the black soil and by the green muscardine [*Metarrhizium anisopliae*] in those that are more acid. The use of mineral fertilisers that increase the acidity of the soil was shown by Mende to increase the rate of infection with *Metarrhizium* and to decrease that by *Tarichium*, while those that render the soil more alkaline had the reverse effect.

It is concluded that in view of the protracted dormancy of the weevils, measures against them should include mechanical control in spring on all fields that have been under beet in any of the preceding three years, and autumn ploughing to stimulate emergence from the soil in the following spring and so clear the fields of infestation.

PYATNIZTKIĬ (G. K.) & PAVLOVA (K. I.). **The Process of Maturation and Oviposition in the Beet Weevil in Nature in Connection with Weather Conditions,** pp. 38–44. Recent observations have shown that, owing

to the low temperatures usual in autumn in the beet-growing areas of Russia, adults of *C. punctiventris* do not become sexually mature in the year in which they emerge from the pupa but enter hibernation while still immature. To complete maturation, they require a temperature not lower than 15–17°C. [59–62·6°F.] and suitable food. In the presence of food, but at temperatures below 15°C., the weevils survive indefinitely but do not mature, while at favourable temperatures and without food, maturation proceeds slowly at the expense of the fat-body, but the weevils die within a month owing to desiccation. If starvation is interrupted, maturation proceeds much more rapidly than in individuals not deprived of food. Under both natural and artificial conditions, starving weevils consumed unusual food, such as *Agropyrum repens* (but not barley), in which case maturation began, but the egg tubes gradually degenerated, the fat-body became exhausted and the weevils died. Owing to low temperatures and to the fact that former beet fields under barley or oats contain few weeds, the weevils usually mature only after migration to new plantations. In the presence of food, the rate of maturation is roughly proportionate to the temperature, though this relation is obscured in the field by the constant movement of the weevils. In moderately favourable, dry and sunny weather, maturation is completed within 1–2 weeks from the beginning of mass migration to beet (which in 1937 occurred on 2nd–3rd May in the northern Ukraine). The oviposition period usually lasts about 45 days in favourable weather [*cf.* **28** 125] ; the number of eggs deposited per day increases for 12–15 days, remains stable for 18–20 days and rapidly decreases during the next 15 days, in the course of which most of the weevils die.

These data indicate that, for 10–12 days from the appearance of the weevils on beet, the application of insecticides should be concentrated on the strips along those edges of the plantations that are close to fields that have been under beet in the preceding three years. As soon as oviposition begins, or even a day or two before, the whole of the infested area should be treated irrespective of the numbers of the weevils present, since even a few may give rise to numerous progeny. The treatment should be repeated 4–5 times at intervals of 4–6 days, so that the plantation remains covered during the period of migration, maturation and oviposition of the majority of the weevils.

Pospelov (V. P.). **Biological Methods of Controlling the Beet Weevil,** pp. 45–46. The most effective natural enemies of *C. punctiventris* in Russia are the green and red muscardine fungi [*Metarrhizium anisopliae* and *Tarichium uvella*]. In experiments the optimum conditions for the development of *Metarrhizium* were a temperature between 22 and 28°C. [71·6–82·4°F.], a relative humidity of 100 per cent. and a medium with a pH of 6·2–4·8. Development was retarded in more acid or alkaline media. It was slow at 16°C. [60·8°F.] and ceased below 10°C. [50°F.]. It occurred when the fungus was placed in contact with water, but not at 70–95 per cent. humidity in the absence of such contact. The percentage of larvae infected was greatest (50 in July–August) in acid soils ; it was only 13 in sandy soils, but *T. uvella* attacked 45 per cent. in the latter. *M. anisopliae* develops either from spores that reach the insect from without or from the stages that occur in symbiosis in the fat-body [*cf.* **27** 306]. Larvae collected in the field and kept between layers of cotton-wool in a test-tube developed infections with both fungi. Attempts to establish *M. anisopliae* in the soil during the period of larval development

or when it was ploughed in autumn were unsuccessful, and spraying adult weevils in beet fields with a culture of the fungus during hot dry weather was ineffective except in one case in which they were particularly abundant ; but the weevils in pits in trap ditches were successfully infected, 92–98 per cent. dying as compared with 27–32 per cent. in the control.

Charkovskiĭ (M. P.). **Basic Laws governing the Behaviour of the Beet Weevil,** pp. 47–50. Much of the information in this paper has already been noticed [**27** 678]. Observations in a district in the central Ukraine showed that, after emerging from the soil in spring, the weevils move in various directions, that they can crawl for distances of over 1,000 yards in a day during the period of mass migration and that practically equal numbers are trapped in ditches running from north to south and from east to west [but *cf.* **29** 578]. Small numbers of weevils emerge from the soil in September-October ; some of these are trapped in ditches or killed by *Metarrhizium anisopliae*, and the survivors hibernate under lumps of earth, plant débris, etc. The beginning of the flight period depends on the weather and the presence of weevils that are not yet actively feeding, pairing and ovipositing. The flight takes place during sunny periods when the surface of the soil is warm, and is negligible if suitable weather sets in late. Most of the weevils migrate to beet fields by crawling, however, even in favourable weather, and observations showed that only a small percentage of the population flies. Those that do so have not fed, and rapidly destroy sprouting beet in fields on which they alight. Flight occasionally occurs in favourable weather in weevils that emerge in autumn ; it was observed on 5th October 1935 when the temperature at the surface of the soil was 26–38·8°C. [78·8–101·84°F.].

Charkovskiĭ (M. P.). **Mechanisation of the mechanical Control of the Beet Weevil.** pp. 51–52. A brief survey is given of work in the Ukraine on the construction of trap ditches against *C. punctiventris* [*cf.* **24** 487, 488 ; **25** 278], and it is pointed out that almost twice as many weevils are caught in ditches 16 cm. [6·3 ins.] deep as in those that are only half as deep but of the same width. If the ditches are narrow, they take less time to make and cause less damage to the crops, while the walls do not dry out and collapse so soon. Where the weevils in trap pits are to be destroyed by fumigation, it is desirable to decrease the diameter of the pits, which is usually 14 cm., so that they will become more quickly saturated with the fumigant.

Negrash (K. A.). **The Rationalisation of the System of Trap and Directional Ditches for the Control of the Beet Weevil,** pp. 53–60. In field experiments in the Ukraine, the numbers of adults of *C. punctiventris* that escaped in two hours from trap ditches of various widths and depths tested in 18 different combinations, varied inversely with the depth of the ditches and directly with their width and the amount of light that penetrated to the bottom. In tests of ditches of equal depth (35 cm.) but varying width and angles of inclination of the walls, the greatest percentage of weevils (70) escaped from the ditch with the greatest width (25 cm.) and vertical walls, but when the bottom of the ditch was wider than the top, less than 1 per cent. escaped. Narrow ditches (8 and 15 cm. wide) with vertical walls retained practically all the weevils in these and subsequent tests. In experiments with trap pits made with different types of drills, the lowest percentage of weevils escaped from those made with a screw-drill and a pointed stake having diameters of 8 and 6 cm. A depth of 25 cm. was sufficient to

retain the weevils for one or two days. The numbers of weevils trapped in shallow ditches running longitudinally or transversely were approximately equal, and it appears, therefore, that it would suffice to make them along the rows of beet only [but *cf.* **29** 578].

PAĬKIN (D. M.). **Improvement of mechanical Control Measures against the Beet Weevil on old Plantations,** pp. 61–68. The possibility of increasing the effectiveness of trap ditches against *C. punctiventris* by making their walls slippery was studied in small-scale field experiments, in which a strip 3–4 cm. wide of a cinematograph or cellulose-acetate film was fixed half-way up the side opposite to the direction from which the weevils were coming. Such ditches retained over 99 per cent. of the weevils that entered them, as compared with less than 80 per cent. in the control.

The weevils can be destroyed in trap pits by fumigation with hydrocyanic acid gas, but as it is dangerous to use and its effect of short duration [*cf.* **24** 489] experiments were carried out on the value of chloropicrin and polychlorides of benzene (which should contain 85 per cent. chlorobenzene) as substitutes for it. The fumigants were introduced into pits 10 cm. and 14·5 cm. in diameter and 35 and 50 cm. deep at the rate of 10 cc. per pit at a temperature of 15–17°C. [59–62·6°F.], known numbers of weevils were placed at the bottom 24 hours later, and the percentage mortalities (which are shown in a table) were estimated on the fourth day. Those given by the polychlorides and chloropicrin were 96 and 27, respectively. When the former was mixed with "autol" and "solidol" they were only 27 and 46, but when chloropicrin was mixed with these substances they rose to 97 and 100, respectively. Hydrocyanic acid gas killed 79 per cent. of the weevils. When used as a contact insecticide, the polychlorides killed the weevils in 5–10 minutes. Their effectiveness as a fumigant decreased after 48 hours, but they subsequently paralysed the weevils, which died if left in the pits. Fumigation should be carried out daily during the mass migration of the weevils and whenever the pits become rapidly filled with them to a depth of more than 5 cm.

A subsidiary experiment showed that the polychlorides could still paralyse high percentages of the weevils after six days if the temperature was 15–17°C., but were practically ineffective at 9–11°C. [48·2–51·8°F.].

In field tests in which the polychlorides were poured into pits 10 cm. in diameter and 35 or 50 cm. deep containing large numbers of weevils, a dosage of 10 cc. was practically as effective as one of 20 cc. The effectiveness of a given dosage decreased as the diameter of the pits was increased, but was not affected by the depth of the pit. The best results were obtained when the polychlorides were applied at the rate of 10 cc. per 75–80 sq. cm. of the bottom of the pit. To test the range of effectiveness of this dosage, weevils were placed in small wire cages on the bottom and at heights of 5, 10 and 15 cm. above it in treated pits. Mortality was excellent at the lower levels, but only slight at 10 and 15 cm. Good results were obtained by spraying the weevils with polychlorides when they covered the bottom of the pit in a layer 5 cm. deep.

DODONOV (B. A.). **The Effectiveness of Sodium Fluosilicate and Barium Chloride as Insecticides against the Beet Weevil,** pp. 73–83. Since laboratory and field investigations have shown that *C. punctiventris* is resistant to arsenicals, experiments were carried out on a small scale with sprays of barium chloride and sodium fluoride and dusts and sprays of sodium and barium fluosilicate, known numbers of weevils

being released in confined areas distributed throughout small plots. There was little difference in the effectiveness of the treatments, but barium chloride showed reduced toxicity at low temperatures.

In experiments on about 1,000 acres of beet in the Province of Kiev, sprays of 0·5 and 0·7 per cent. sodium fluosilicate were applied by ground machinery at the rate of 36 gals. per acre and sodium-fluosilicate dust was applied from an aeroplane at the rate of 7·2 or 9 lb. per acre. The results were compared with those given by a 5 per cent. solution of barium chloride applied from the ground at the rate of 36 gals. per acre and a 15 per cent. solution applied from an aeroplane at 5·4 gals. per acre. Mortality was estimated by daily counts of live and dead weevils on the ground and in soil samples taken to a depth of 2 cm., beginning when the weevils first appeared in the fields. During the period of intensive migration, the treatments were confined to the edges of the fields and were repeated at intervals of 3–5 days, and when most of the weevils had settled on the beet, the whole area was treated 5 or 6 times at intervals of 3–15 days. At first, the percentage mortality was very low, owing to the influx of migrating weevils, but it became gradually higher and more or less stable. Mortality was high for all treatments, averaging about 80 per cent., with maxima of 90 or even 95 in some instances. Sodium fluosilicate at 0·7 per cent. proved very effective, so that the officially recommended concentration of 0·8 per cent. is excessive. Dusting and spraying from an aeroplane were as effective as ground treatments, and could well be adopted in practice. Injury to the plants was slight. Since barium chloride and sodium fluosilicate do not adhere long to the surface of the leaves, only half the initial amount remaining on them two days after treatment and less than a quarter on the fourth day, the intervals between treatments should not exceed 3 days for the edges of fields and 5 days for the entire plantation. The examination of samples of soil showed that when the entire plantations were treated at frequent intervals during the period of intense oviposition, which usually occurs between 20th May and 15th June, the larval population was only 15–20 per cent. of that in fields treated twice in the last week of May.

Kozlova (E. N.). **The Application of concentrated Solutions of Barium Chloride for the Control of the Beet Weevil,** pp. 84–91. An account is given of experiments in the northern Ukraine on the possibility of reducing the cost of spraying against *C. punctiventris* on beet by the use of more concentrated sprays. Those tested were 9 and 15 per cent. solutions of barium chloride [*cf.* **29** 584] applied at rates of about 12 and 7 gals. per acre, respectively, and they were compared with a 3 per cent. solution applied at the usual rate of 36 gals. per acre. By each rate of application, the amount of barium chloride per acre was 10·8 lb. The 15 and 9 per cent. solutions gave average percentage mortalities of 81·7 and 77·7 in three days, and the difference between these figures was not significant. Both were markedly superior to the 3 per cent. spray, which gave only 62·1 per cent. mortality in 3 days. For comparison, it is recalled that in previous experiments by B. A. Dodonov, a 5 per cent. solution of barium chloride applied at the rate of 36 gals. per acre gave only 54·8 per cent. mortality. The difference between this and the result given by the 3 per cent. spray was not significant. Quantitative determination of the deposits of barium chloride on the beet leaves showed no important differences between any of the sprays, but when the 15 per cent. solution was applied from an aeroplane at the rate 3·6 gals.

per acre the deposit was significantly less, doubtless owing to the reduced rate of application. In all the experiments, the amounts of barium chloride that adhered to the leaves three and five days after spraying were about 36·5 and 10 per cent. of the initial quantities.

Novichkov (F. S.). **Results of Experiments in the Aviochemical Control of the Beet Weevil,** pp. 107–118. An account is given of experiments in the northern Ukraine on the control of *C. punctiventris* by means of a dust of sodium fluosilicate and a spray of barium chloride applied from an aeroplane. The evenness of the distribution was estimated by means of slides coated with a thin film of glycerine and placed at numerous points in the experimental plots. It was shown that dusting can be satisfactorily carried out if the velocity of the wind is not greater than 2 metres per second [4½ miles per hour], and spraying if it is not more than 4 metres per second. The aeroplane should fly at a height of 10 ft. from the ground when there is wind, and at about 18 ft. for dusting and 26 ft. for spraying if there is no wind. The width of the effective swath depended on the weather, the height at which the aeroplane flew and the quality of the poison, and varied from 65 to 82 ft. for dusting and from 32 to 38 ft. for spraying. In the dusting experiments, strips about 300 ft. wide along the edges of the fields were treated twice and the entire fields five times. The percentage mortality obtained was 70–90, whether the poison was applied at the rate of 7·2 or 10·8 lb. per acre, this result being as good as, or slightly better than, that obtained by dusting from the ground. In the spraying experiments a 15 per cent. solution of barium chloride was applied at the rate of about 5 gals. per acre. The edges of the fields were sprayed twice and the whole field four times. Satisfactory coverage of the plants was obtained, and the percentage mortality of the weevils was again 70–90, which was as good as that given by the usual ground spraying with a 5 per cent. solution. at a rate of 36 gals. per acre.

Calculations of the costs showed that treatment from aircraft is cheaper than that from the ground, other advantages being considerable economy in labour, the rapidity of application, the possibility of treating fields with narrow spaces between the rows of beet, and the absence of injury to the plants. It is, therefore, recommended for general use.

Glebov (M. A.). **Means of reducing the Cost of the chemical Method of controlling the Beet Weevil,** pp. 119–123. As a result of investigations on methods of reducing the cost of controlling *C. punctiventris* with insecticides, a table is given showing the technical effectiveness of various types of apparatus, chiefly sprayers, that were tested experimentally. A reduction of 30 per cent. in the cost of spraying without loss of efficiency is obtained by applying 2–5 lb. sodium fluosilicate per acre in a 0·7 per cent. solution instead of the usual 18 lb. barium chloride in a 5 per cent. solution. The application of 10·8 lb. barium chloride per acre in a 15 per cent. solution by means of special nozzles reduces the cost of spraying by 42 per cent.

Zverezomb-Zubovskiĭ (E. V.). **The System of Control Measures against the Beet Weevil,** pp. 124–130. The author reviews the agricultural, mechanical and chemical measures that should be adopted to safeguard beet from infestation by *C. punctiventris*. The cultural measures include timely ploughing in autumn and early spring; separating new beet fields from old ones by as long a distance as possible; early sowing of the beet, carried out as nearly at the same

time as possible over the whole area so as to secure an even and simultaneous sprouting of the plants; better cultivation; the use of fertilisers, especially those containing potash, to assist the growth of the plants at the critical period of their development between germination and the appearance of the second pair of leaves; thinning the beet; repeated loosening of the soil in May and June to reduce the numbers of the larvae; and destruction of weeds. The other measures comprise the proper use of systems of trap ditches, and the application of insecticides as soon as the beet shows above ground, fluorine compounds being particularly recommended, since they are the least injurious to the plants.

Chen (S. H.). **Notes on Chinese Eumolpidae.**—*Sinensia* **11** no. 5–6 pp. 483–528. Peipah, 1940. [Recd. 1942.]

The author discusses the classification of the genera of the Eumolpids that occur in China and gives keys to the genera and lists of species recorded from China for the first time, with descriptions of many new ones, and of species that feed on cultivated plants there. Of the latter, those stated to cause serious injury are *Pagria signata*, Motsch., of which the adults feed on the leaves and the larvae on the roots and on seedlings of soy beans, *Acrothinium gaschkevitchi*, Motsch., and *Scelodonta lewisi*, Baly, which injure the foliage, shoots, stems, flower buds and roots of grape vines, and *Chrysochus chinensis*, Baly, the larvae of which gnaw the tubers of sweet potato.

Chen (S. H.). **Rectifications of the Nomenclature of some Trypetidae.**—*Sinensia* **11** no. 5–6 p. 529. Peipah, 1940. [Recd. 1942.]

The author states that *Mellesis citri*, Chen [*R.A.E.*, A **29** 524] is a synonym of *Dacus* (*Tetradacus*) *tsuneonis*, Miyake [**7** 238].

Young (B.). **Two Caterpillars injurious to Ramie in Kwangsi.**—*Sinensia* **11** no. 5–6 pp. 577–587, 21 figs., 5 refs. Peipah, 1940. [Recd. 1942.]

Detailed descriptions are given of the larvae of the Nymphalids, *Vanessa* (*Pyrameis*) *indica*, Hbst., and *Acraea issoria*, Hb. (*Pareba vesta*, F.), both of which do considerable damage to the leaves of ramie (*Boehmeria nivea*) in Kwangsi. The latter is apparently the more important.

Ramchandra Rao (Y.) & Cherian (M. C.). **Control of the Rice Grasshopper.**—*Indian Fmg* **1** nos. 9–10 pp. 433–436, 495–498. Delhi, 1940. [Recd. 1942.]

Three of the known species of *Hieroglyphus* [*cf.* *R.A.E.*, A **10** 529] are of economic importance in South India, *viz.*, *H. banian*, F., which is found throughout Madras, mostly on rice, but also on sugar-cane and various millets; *H. oryzivorus*, Carl, which, in that Province, is limited to the more northerly districts and is found on rice; and *H. nigrorepletus*, Bol., which occurs on the upland areas as a minor pest of maize and millets, including sorghum, *Setaria* and *Pennisetum typhoideum*. The bionomics of *H. banian* are described [*cf.* **21** 675]. The young hoppers feed on grasses on the bunds of rice-fields, later

moving in to the crop ; in the case of sugar-cane, the eggs are laid in the fields and the hoppers attack the crop from the outset. The more densely overgrown parts of a field are more subject to attack and the lower leaves and young side-shoots are attacked first, so that the damage may not be apparent at first sight, but in the case of rice it results in considerable stunting. The adult grasshoppers attack the ears of rice in the shot-blade stage, nibble the florets, or damage the bases of the ear-stalks, causing an appearance of white and empty ears, similar to those due to stem-borer attack. The percentage of damaged ears may average 10–30, and the total loss in grain may reach 50 per cent. ; in cases of damage to the young crop, up to 90 per cent. may be lost. The effects of attack are less serious on sugar-cane, which remains in the ground long enough to recover from them. *H. banian* has one generation a year, and passes the dry period (October–March) in the egg stage. The first rains cause the eggs to develop, and if they are followed by a spell of drought, the eggs may become shrivelled and die. On the other hand, many of the hoppers are killed if heavy rain occurs when they are hatching or while they are still small. Thus years of moderate rainfall appear most favourable for the grasshopper.

Natural enemies include the fungus, *Empusa grylli*, Nematodes (probably *Gordius* sp. and *Mermis nigrescens*), red mites, blister beetles, and various vertebrates. Control measures should be directed against the eggs, which are concentrated on the tops and sides of the bunds in rice-fields. These should be thoroughly scraped to a depth of 2–3 inches soon after the harvest, thus damaging and exposing the egg-masses [*cf.* **21** 675]. In districts in which the sides of bunds are regularly trimmed, no trouble from grasshoppers is normally experienced. When the bunds are dug, or scraped, it is necessary to break up large clods of soil, in which the egg-masses will otherwise remain unaffected by weather. In sugar-cane fields, the eggs are usually laid on the cane ridges and can be exposed by ploughing after the cane is removed. In the case of fields in which the cane remains standing for over a year, the trenches between the ridges should be lightly ploughed and the sides and tops of ridges between clumps of cane scraped with a spade to a depth of 2–3 inches. Collecting by hand-nets has been found effective against the hoppers, particularly when they are small and the crop is not too dense and tall.

RATCLIFFE (F. N.) & CUMMINS (J. E.). **Termite (White Ant) Research in Australia.**—*Imp. For. J.* **18** no. 2 pp. 221–228. London, 1939. [Recd. 1942.]

This is a review of work on the biology, ecology and control of termites carried out in Australia under the Council for Scientific and Industrial Research [*cf. R.A.E.*, A **29** 142, etc.]. Of more than 150 species that occur in Australia, only a few are injurious to timber. They are widely distributed, however, and Melbourne is the only mainland State capital in which termite damage is not more or less severe. South of the Tropic of Capricorn, probably 90 per cent. of the damage is caused by *Coptotermes* spp., of which *C. acinaciformis*, Frogg., is the most important and has become well adapted to city conditions. *Rhinotermes intermedius*, Brauer, is injurious in some places. *Mastotermes darwiniensis*, Frogg., occurs in the tropical belt and forms large colonies in built-up areas. *Eutermes exitiosus*, Hill, is widely distributed and is injurious to timber in country houses near Canberra. It does

not thrive, however, in towns. Termite damage to living trees is negligible in the Australian rain-forests but is sometimes severe in the forests of *Eucalyptus*, the most harmful species in eastern Australia being *C. acinaciformis*, *C. frenchi*, Hill, *Kalotermes* (*Calotermes*) *insularis*, Wlk., and *Porotermes adamsoni*, Frogg.

Investigations in northern New South Wales have shown that the degree of infestation of living forest trees is not always correlated with the degree of resistance exhibited by the seasoned timber. *Eucalyptus maculata*, the timber of which is susceptible to attack by *C. acinaciformis*, is rarely attacked by it in the forest, whereas *E. hemiphloia* and *E. propinqua* are frequently infested there, although the timber from both is highly resistant. Attack on trees by *C. acinaciformis* is confined to a narrow pipe running up the centre of the trunk, and this suggests that it may be associated with a pathological change in the heartwood. *K. insularis* and *P. adamsoni* both enter trees only through the exposed dead wood of fire scars or branch stubs.

The control of termites that attack structural timber is discussed in some detail, and methods for testing the effectiveness of chemical wood preservatives are described [**26** 449 ; **27** 545]. Satisfactory penetration of preservatives into the heartwood of native hardwood trees is difficult to obtain, but the sapwood can be made to absorb them comparatively easily, and poles from which the sapwood has not been removed can readily be protected by this means. An alternative treatment is to remove the sapwood from the ground line area and brush or spray the exposed heartwood with creosote oil. The absorptive capacity can be increased by charring the seasoned heartwood with an oxyacetylene torch to obtain a layer of completely or partly carbonised wood. When the pole is erected, the soil adjacent to it is puddled with creosote to a depth of 12–18 ins. Periodical re-treatment is necessary, and unless wood to be charred is first seasoned, untreated wood will be exposed by subsequent cracking.

Laboratory studies have shown that the resistance to attack of most Australian timbers is very variable, and in some cases no attempt at classification was possible ; this variability is due to the differences in the digestive habits of the termites that attack them, which belong to three different families. *Eucalyptus marginata*, which in practice is highly resistant to *Coptotermes acinaciformis*, was in laboratory tests susceptible to *Eutermes exitiosus*, whereas *Araucaria cunninghamii*, which is readily attacked by the former, was fairly resistant to the latter. *Eucalyptus siderophloia* is resistant to *Eutermes*, but *Mastotermes darwiniensis* preferred it to the highly susceptible *Eucalyptus regnans*. The timbers of certain trees, including species of *Callitris*, however, can safely be recommended as highly resistant, and the local timbers that can be used in the ground or in unprotected situations in any district can be determined by experience.

ATHERTON (D. O.). **Codling Moth Control.**—*Qd agric. J.* **55** pt. 3 pp. 183–188, 10 figs. Brisbane, 1941.

A brief account is given of the bionomics of the codling moth [*Cydia pomonella*, L.] in Queensland, where there are two generations a year and sometimes a partial third. Apple and pear are the only fruits seriously attacked in the Stanthorpe district. Recommendations are given for control by spray programmes in which the use of lead

arsenate is confined to the calyx spray and cover sprays are timed by means of bait traps [*cf. R.A.E.*, A **29** 238], supplemented by orchard hygiene and tree banding.

SLEESMAN (J. P.). **Resistance in wild Potatoes to Attack by the Potato Leafhopper and the Potato Flea Beetle.**—*Amer. Potato J.* **17** no. 1 pp. 9–12. 1940. (Abstr. in *Exp. Sta. Rec.* **84** no. 2 p. 216. Washington, D.C., 1941.)

An account is given of a survey of the populations of the potato leafhopper [*Empoasca fabae*, Harr.] and the amount of feeding by adult flea-beetles [*Epitrix cucumeris*, Harr.] on 12 species of *Solanum* in Ohio. In 1938, the rate of mortality of the Jassid nymphs on four species of *Solanum*, and the amount of feeding by the adult flea-beetles on two species of *Solanum* were determined in laboratory tests. *S. polyadenium*, *S. chacoense*, *S. commersonii* and *S. caldasii* were found to be highly resistant to, if not immune from, attack by *E. fabae*. *S. bulbocastanum* showed fair resistance to attack by *E. cucumeris*, while only slight feeding occurred on *S. polyadenium*, which was almost immune.

FICHT (G. A.), HIENTON (T. E.) & FORE (J. M.). **The Use of Electric Light Traps in the Control of the European Corn Borer.**—*Agric. Engng* **21** no. 3 pp. 87–89, 2 figs. 1940. (Abstr. in *Exp. Sta. Rec.* **84** no. 2 p. 219. Washington, D.C., 1941.)

In preliminary studies of the attraction of electric light traps for the European corn borer [*Pyrausta nubilalis*, Hb.] on maize in Indiana [*cf. R.A.E.*, A **28** 175], a total wattage of 2,000 per acre resulted in the almost complete elimination of borer infestation within the lighted area. Later work led to a reduction in the number of lamps used per unit area, with consequent reduction in the cost of installation and operation. Several factors appear to influence the numbers of moths caught at various traps or to have a bearing on the flight of the adults to lights, the most important being the height of the maize under or round the surrounding traps, their height above the maize, their position with regard to prevailing winds and their distribution as regards topography or contour of the lighted area. Such influences are not easily segregated into individual factors, but the height of the maize in the immediate vicinity of the traps [*cf. loc. cit.*] appears to be the most important single factor determining the flight of moths to traps of equal light intensity.

McCOY (E. E.) & CARVER (C. W.). **A Method for obtaining Spores of the Fungus** *Beauveria bassiana* **(Bals.) Vuill. in Quantity.**—*J. N. Y. ent. Soc.* **49** no. 2 pp. 205–210, 1 fig., 4 refs. New York, N.Y., 1941.

The following is substantially the authors' summary. A procedure for culturing and obtaining large quantities of spores of the entomogenous fungus, *Beauveria bassiana*, is described. It is suggested that the methods are adaptable for use with other fungi. The fungus is

cultured on autoclaved, moistened wheat bran, and the yield of spores is much heavier than occurs on commonly used culture media. The spores can be readily obtained in an almost pure condition by an air separation and filtration method. The construction of a simple separator and filter is described.

FRANKLIN (H. J.) & others. **The Cranberry Station, East Wareham, Massachusetts.**—*Bull. Mass. agric. Exp. Sta.* no. 369 (Rep. 1939) pp. 33–38, 1 ref. Amherst, Mass., 1940. [Recd. December 1941.]

In 1939, over 100 acres of cranberry in Massachusetts were infested by *Cryptocephalus incertus*, Ol., some adults of which were found by 7th August ; treatment just after mid-August with 250 U.S. gals. per acre of a spray containing 3 lb. lead arsenate per 100 U.S. gals. water gave effective control. Application early in June of a bait of 100 lb. bran and 5 lb. sodium fluosilicate per acre, moistened with oil or water, was completely ineffective against the adults of *Anthonomus musculus*, Say, which was more prevalent than usual, but a spray of 9 lb. Alorco cryolite in 100 U.S. gals. water, applied at the rate of 400 U.S. gals. per acre on 31st July, killed 80 per cent. of the newly emerged weevils. A considerable infestation of adults of *Clastoptera saint-cyri*, Prov., was eradicated by dusting with 100 lb. per acre of derris (4 per cent. rotenone), without an activator or wetter. Adults of *Colaspis brunnea* var. *costipennis*, Crotch, were numerous in a cranberry bog in late June and early July and fed freely on the foliage, flower buds and flowers ; the larvae had eaten the fibrous roots and the bark just below the surface of the sand. This Eumolpid appears to hibernate in the larval stage, since half-grown larvae were found in the cranberry turf of the infested area in autumn. The infestation had evidently been present for some years.

Serious damage by the Pyralid, *Tlascala finitella*, Wlk. (hill fireworm), the larva, pupa and adult of which are described, occurred in an area at Greene, Rhode Island, that had been replanted in spring. The larvae were most active in late July and destroyed all foliage on the cranberry vines over about 1½ acres, but did not occur in areas well covered by the plants. From one to three larvae were found on the sand and close to the bases of the plants of each hill. They spun silk very copiously round the lower parts of the plants and left a thick mass of frass and dropped leaves round them. Some had pupated in cocoons on the surface of the sand by 2nd August and practically all had done so by 16th August. Adults emerged from 20th August to 5th September, and pupae that had not transformed by 27th November appeared to be parasitised. Little was previously known of the biology of this moth, which occurs from Canada to Florida, but is commoner in the south.

Dusting with derris or with mixtures of derris and pyrethrum failed to control the larger larvae of *Lymantria* (*Porthetria*) *dispar*, L., which was more destructive over a limited area than in 1938. Studies of the life-history of *Amphicoma vulpina*, Hentz (cranberry root grub) have shown that the larvae remain in the soil for 4–5 years. The cyanide treatment against this Lamellicorn [wetting the surface soil with a solution of sodium cyanide (*cf. R.A.E.*, A **14** 67)] is extensively used but is sometimes ineffective and takes too much time to apply. In experiments on infested plots in late April, sodium fluoride, applied to the soil as a dust or in water, and semi-colloidal lead arsenate in water were ineffective, and most of the sodium fluoride treatments injured

the cranberry vines ; sodium arsenite in water killed both larvae and plants. Dichloroethyl ether in water (1 : 400) applied at the rates of 1, 2 and 4 U.S. quarts per sq. ft. on 13th October killed 12 of 32, 33 of 64 and all of 31 larvae, respectively, by 20th November, but the vines that received the heaviest dosage were badly injured. There appears to be a small general increase of this pest each year. *Mineola vaccinii*, Riley, was satisfactorily controlled with sprays and dusts of materials containing rotenone [*cf.* **26** 646] ; only 1½ lb. soap per 100 U.S. gals. water was necessary in the sprays. A dust containing 2 per cent. rotenone and an activator and wetter, applied twice at the rate of 100 lb. per acre, was highly effective, whereas those containing only 1½ or 1 per cent. rotenone failed to give satisfactory control. A derris dust containing 4 per cent. rotenone without an activator was satisfactory at 50 lb. per acre. A spray of 6 lb. Alorco cryolite per 100 U.S. gals., at the rate of 400 U.S. gals. per acre, and cryolite dust at 30 lb. per acre, applied on 15th and again on 25th July, gave almost complete control of the larvae without materially damaging the plants. The fluorine residues on the berries were far below the tolerance of 0·02 grain per lb. fruit, but over four inches of rain fell in a single storm between treatment and the picking of the samples. Spraying plants on which a third of the berries were infested on 10th August gave excellent control, and the berries had a fluorine residue of 0·00084 grain per lb. on 19th September. It is suggested that rotenone materials should be used in the first treatment, because they are somewhat safer and also control other pests, and cryolite dust in the second, because of its lower cost. It leaves less residue than the spray and is less likely to harm the crop at this time than earlier in the season.

The second generation of the black-headed fireworm, *Rhopobota* [*naevana*, Hb.], was controlled with derris dust containing 4 per cent. rotenone without an activator, applied at about 50 lb. per acre. This Tortricid was more prevalent than in the previous year, but suffered high mortality from disease. Derris dusts diluted to contain 1 and 1·5 per cent. rotenone, with camphor oil and ground-nut oil, respectively, as the activator and a wetter, applied once, early in July, at 95 and 100 lb. per acre, both gave at least 94 per cent. mortality of the blunt-nosed leafhopper (*Ophiola*). The results of commercial control of this Jassid have indicated that treatment should be carried out thoroughly when more than three leafhoppers are taken by 50 sweeps of an insect net, but is usually necessary only once in three years. The tipworm, *Dasyneura* [*vaccinii*, Smith], was widely prevalent.

Alexander (C. P.) & others. **Department of Entomology.**—*Bull. Mass. agric. Exp. Sta.* no. 369 (Rep. 1939) pp. 45–50, 57–66, 2 figs. Amherst, Mass., 1940. [Recd. December 1941.]

In investigations in Massachusetts in the year ending 30th November 1939, dormant sprays containing oil and dinitro-ortho-cyclohexylphenol or dinitro-ortho-cresol, and a proprietrary spray material (Elgetol) consisting of a sodium salt of dinitro-o-cresol and reported to contain no oil proved toxic to the overwintering eggs of Aphids, which were very abundant on fruit trees, and caused no damage to fruit or leafbuds. The dinitro-o-cyclohexylphenol sprays also controlled Aphids and Coccids on various ornamental trees and shrubs, and caused little, if any, damage to the deciduous species, but very general injury to almost all

types of evergreen. Sprays of oil with dinitro-o-cyclohexylphenol, dinitro-o-cresol or nicotine sulphate and a spray of sodium dinitro-cresylate all gave effective control of the bud moth [*Spilonota ocellana*, Schiff.] on apple; they were applied on 23rd and 24th April, when the buds were in the silver-tip stage, and caused considerable injury to fruit and leaf buds, the mixtures containing dinitro-o-cresol appearing to injure the trees least. Heavy residues on apples sprayed with lead arsenate were difficult to avoid in 1939, owing to the drought of mid-summer; the lead and arsenic residues on the fruits were more than twice and three times as great when the sprays contained lime-sulphur as when they contained wettable sulphur. The use of supplementary sprays of a commercial fixed-nicotine compound in late summer improved the control of late-season larvae of the codling moth [*Cydia pomonella*, L.].

The apple maggot [*Rhagoletis pomonella*, Walsh] was more abundant than in 1938, and much more injurious than in 1937 [*cf. R.A.E.*, A **26** 647]. The proper timing of sprays against it was rendered difficult in some orchards, because the emergence of the adults was interrupted and delayed by the protracted drought. Emergence and oviposition of the apple leaf-curling midge, *Dasyneura mali*, Kieff., occurred mainly during 1st–9th June, 7th–18th July and 15th–25th August, and maximum catches of larvae seeking sites for pupation were made on 23rd June, 1st August and 5th September. Only 21 per cent. of the larvae collected in August, and none of those collected in September gave rise to adults before the winter. Soil treatment with naphthalene flakes, applied at the rate of 2 lb. per 100 sq. ft. just before the emergence of the adults, gave complete control of those of the second generation, and an application of 1 lb. per 100 sq. ft. followed by cultivation was nearly as effective, and gave better control than the same amount without cultivation. The numbers of first- and second-generation adults were reduced by 71 and 99 per cent., respectively, by cultivation alone. The plum curculio [*Conotrachelus nenuphar*, Hbst.] was the most destructive pest of apple in many orchards. A single spray of 4 lb. lead arsenate, 4 lb. wettable sulphur and 1 lb. soy-bean flour per 100 U.S. gals. was more effective when applied on 3rd June, when the fruits were about ¼ inch in diameter, than on 1st or 6th June.

Some 13,000 examples of *Macrocentrus ancylivorus*, Rohw., were liberated against the oriental fruit moth [*Cydia molesta*, Busck] on peach, but dry weather had so retarded the growth of the peach twigs that the host larvae began to enter the fruits soon after they were formed in many orchards, and were, therefore, not very accessible when the parasites were released. In preliminary tests, some fixed-nicotine compounds gave promising control of *C. molesta* late in the season.

Studies were carried out on *Oxyptilus periscelidactylus*, Fitch [*cf.* **29** 133] and *Ampeloglypter ater*, Lec., both of which were numerous on grape-vines in eastern Massachusetts. *Ampeloglypter* girdled 75 per cent. of the new canes on some vines. This weevil has one generation a year and overwinters in the adult stage. Oviposition begins early in June, when the canes are 6–8 ins. long, and continues for about a month. The egg is usually laid just above a ring of holes that girdles the cane and causes it to break. The egg, larval and pupal stages lasted about 12, 27 and 12 days, and the adults, which emerge early in August, feed slightly on the veins on the underside of the leaf before entering hibernation. Spraying with lead arsenate and calcium

arsenate greatly reduced injury by the adults, but did not prevent them from girdling the canes.

Infestation of untreated squash by the borer [*Melittia satyriniformis*, Hb.] averaged 3·24 larvae per vine, but owing to favourable growing conditions the yield was not much affected by it. Applied four times in July at intervals of a week, nicotine sulphate (1 : 250), nicotine sulphate (1 : 500) with 1 per cent. summer-oil emulsion, and wettable derris spray (4 lb. per 100 U.S. gals.) with a resin adhesive reduced the infestation by 74, 77 and 35 per cent., respectively, a dust of derris and clay (0·75 per cent. rotenone) did not reduce it, and proprietary dusts containing a fungicide and rotenone (0·8 per cent.) or calcium arsenate allowed it to increase by 27 and 33 per cent. The dusted plants, however, yielded more than the sprayed ones, probably owing to the beneficial effect of fungicides in two of the dusts, and to the unimportance of such low infestations under favourable growing conditions. The striped cucumber beetle [*Diabrotica melanocephala*, F.] was normally abundant on cucumbers and cantaloupe melons, but the yield was little affected as dry weather prevented the development of bacterial wilt. A heavy infestation of melon aphis [*Aphis gossypii*, Glov.] led to a general infection with cucumber mosaic. Dusts were applied against *D. melanocephala* seven times between 17th June and 15th July and four additional applications were made between 27th July and 26th August. The most effective were calcium arsenate mixed with talc, red copper oxide and flour, with talc alone, or with monohydrated copper sulphate and lime, cubé with talc (0·75 per cent. rotenone) and a rotenone dust (0·8 per cent.), all of which gave at least 80 per cent. reduction of the beetle population on cucumbers and 90 per cent. on cantaloupes. The calcium-arsenate dusts gave better yields and were cheaper than the rotenone dusts. The mixtures of calcium arsenate with copper oxide or copper sulphate were the most effective on cucumber, but the latter caused slight to moderate foliage injury. Applications of fibrous talc alone gave 79 per cent. protection, but a spray of wettable derris was ineffective.

The cabbage maggot [*Hylemyia brassicae*, Bch.] did rather more damage to cabbage than usual ; one and two applications of mercury bichloride (corrosive sublimate) at the rate of 1 oz. in 10 U.S. gals. water gave 98·67 and 99·33 per cent. protection and 87·25 and 93·25 per cent. marketable heads, respectively [*cf.* **26** 647]. Treating the roots with dusts containing 25 per cent. or more of mercurous chloride (calomel) in talc gave at least 90 per cent. protection, but plants treated with dusts containing 50 per cent. or more produced only 57–70 per cent. marketable heads, indicating delayed growth, whereas those treated with dusts containing only 5–25 per cent. produced 78–80 per cent. marketable heads in spite of relatively severe damage by the larvae. A dust containing 50 per cent. mercurous chloride gave better protection and a higher yield with gypsum as the carrier than with talc, in spite of apparently poor adhesion when applied. The prolonged drought caused severe injury to onion and permitted the rapid increase of onion thrips [*Thrips tabaci*, Lind.]. In field tests against it, a spray of nicotine sulphate and soap was superior to any other insecticide, giving 95 per cent. effective control. Sprays containing rotenone with oil, nicotine with oil, and derris alone or with talc or cherokee clay as adhesives were superior to sprays of pyrethrum with oil or with sulphur, or a pyrethrum-sulphur dust. Derris showed a marked residual effect ; its effectiveness was somewhat improved

by the addition of talc or clay. Calcium cyanamide used as a dust failed to kill the thrips in quantities that were not toxic to the plants. Flea-beetles [*Epitrix cucumeris*, Harr.] were abundant on potato throughout the season, particularly in late July and early August; leafhoppers [*Empoasca fabae*, Harr.] did not appear till late in the season and were not abundant. *Epitrix* caused more damage on plots that received 12 applications between 13th June and 6th September of standard Bordeaux mixture (5 : 5 : 50) than on those treated with Bordeaux mixture containing half the quantity of lime; the latter showed more tendency to scorch the plants, thus reducing the yield, but the addition of calcium arsenate somewhat reduced the injury. A heavy infestation of potato aphis [*Macrosiphum solanifolii*, Ashm.] developed by early August, but the addition of nicotine sulphate to two sprays in August practically eliminated it.

Early maturing sweet maize was treated five times at intervals of five days from 8th June for the control of the European corn borer [*Pyrausta nubilalis*, Hb.]. The percentages of uninfested ears were 81 and 84 for sprays of derris and cubé (both powders containing 4 per cent. rotenone), 72 and 65 for commercial sprays containing 4 and 2½ per cent. rotenone, 77, 71 and 76 for a dust of dual-fixed nicotine and two commercial rotenone dusts, and 40 for no treatment. The European earwig [*Forficula auricularia*, L.] is established in southern Bristol county, where it causes annoyance to householders and is a minor pest of plants. In June and July, 1,000 adults of the parasite, *Bigonicheta setipennis*, Fall., were received from Washington State and liberated at 11 localities in the infested area, and on 16th August, two puparia of this Tachinid were found at one liberation point. Experimental fumigation with chlorinated naphthalene compounds showed that mixtures of three parts chloronaphthalene oil and one part crystal naphthalene or chloronaphthalene soft wax were noticeably more effective against red spider [*Tetranychus telarius*, L.] on carnation than a mixture containing equal parts of chloronaphthalene oil, crystal naphthalene and paradichlorobenzene. When used at the rate of ½ oz. per 1,000 cu. ft. for 6 hours at a relative humidity of 60 per cent., these materials were more effective at 70 than at 60 or 75°F. Two successive fumigations with the first two mixtures gave an average kill of 98·5 and 99·5 per cent., respectively, and did not injure the plants. Under normal greenhouse conditions, derris or cubé powder containing 4 per cent. rotenone, mixed with sulphonated castor oil (1 : 300) and diluted at the rate of 2 and 3 lb. per 100 U.S. gals., gave only moderate control of *T. telarius* on rose after three applications at weekly intervals, but good control after four.

Records are given of the course of development in elm logs of the Scolytids, *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., and *Scolytus multistriatus*, Marsh., which are concerned in the dispersion of the fungus [*Ophiostoma ulmi*] causing Dutch elm disease. To determine the effect of solar heat on the subcortical development of *H. rufipes*, infested logs were placed on open ground or under the shade of a tree. Complete mortality occurred in the upper halves of all logs in the sun but one, which had relatively thick bark and was exposed for only one day; in this, 2 larvae, 1 pupa and 2 adults on the east side and only just in the upper half were alive. Living individuals were found in the lower halves of the logs in the sun and both halves of logs in the shade, and later such shaded bark showed emergence holes, indicating that the beetles had completed their development.

DA FONSECA (J. P.). **Ação contra as moscas das frutas.** [Work against Fruit-flies.]—*Biologico* **7** no. 6 pp. 159–162. São Paulo, 1941.

In view of the growing importance of *Citrus* cultivation in São Paulo, there is urgent need for measures against Trypetids, including *Ceratitis capitata*, Wied., and several native fruit-flies, of which one of the most important is *Anastrepha fraterculus*, Wied. These are widely distributed in the State and breed on wild and cultivated fruits throughout the year, so that only a thoroughly organised system of control measures would have any likelihood of reducing their numbers. In addition to the development of biological control [*cf.* *R.A.E.*, A **27** 34 ; **29** 344], the measures recommended are the use of bait-traps and insecticidal sprays and the destruction of all infested fruits, all alternative food-plants in and near orchards, and all abandoned orchards.

BETREM (J. G.). **Verdere gegevens omtrent de bestrijding van de *Helopeltis* door middel van derrispoeder.** [Further Data on the Use of Derris Powder against *Helopeltis*.]—*Bergcultures* **15** no. 9 pp. 238–249, 6 graphs. Batavia, 1941.

Further field experiments with derris dusts against Capsids of the genus *Helopeltis* on cacao in Java [*cf.* *R.A.E.*, A **28** 512] are described and discussed. They confirmed that thorough applications at fortnightly intervals of a sufficiently fine derris dust containing 0·75 per cent. rotenone are very effective. Control of the adults was not improved by dusting the pods a week after the main applications to the trees, although the numbers of nymphs were greatly reduced, and spraying the pods with lead arsenate a week after dusting had no effect on the population. Dusting should be begun when more than 80 adults are caught per 100 full-grown trees. The amount of dust that should be applied per acre of about 140 trees was not determined, but in one test 44 lb. was as effective as a greater quantity and in another 16–18 lb. gave good results. Dusting with derris increases the setting of the fruit, and reduces the loss of young fruits due to *Helopeltis*.

THORPE (W. H.). **A Description of six new Species of the Genus *Cryptochaetum* (Diptera-Agromyzidae) from East Africa and East Indies ; together with a Key to the Adults and Larvae of all known Species.**—*Parasitology* **33** no. 2 pp. 131–148, 30 figs., 16 refs. London, 1941.

The new species described are *Cryptochetum striatum* reared from *Aspidoproctus maximus*, Newst., and *C. tuberculatum* from *A. bifurcatus*, Thorpe, and *A. glaber*, Ldgr., on *Inga vera*, both in Tanganyika Territory ; *C. brachycerum* from *Monophlebus* sp. on *Acacia* in Kenya ; *C. pariceryae* from *Icerya* sp. in Uganda ; *C. oocerum* from an unidentified Coccid on *Achras sapota* in Lombok (Sunda Islands) ; and *C. idiocerum*, the host of which is unknown, from Uganda.

THORPE (W. H.). **The Biology of *Cryptochaetum* (Diptera) and *Eupelmus* (Hymenoptera) Parasites of *Aspidoproctus* (Coccidae) in East Africa.**—*Parasitology* **33** no. 2 pp. 149–168, 26 figs., 17 refs. London, 1941.

The following is substantially the author's summary. The larvae of Dipterous and Hymenopterous parasites of scale insects often show

striking respiratory and other adaptations correlated with the degenerate structure and organisation of the host. The larger the host, the greater must be the problem of respiration. *Aspidoproctus maximus*, Newst., is a very large Monophlebine that infests leguminous trees and shrubs in East Africa from Kenya to Southern Rhodesia. Its main anatomical and biological features are described, including the very hard and thick dorsal body wall, the large invaginated marsupium in which the eggs hatch and the adaptation of the young for wind dispersal. The Agromyzids of the genus *Cryptochetum* are highly specialised parasites attacking Monophlebine scale insects throughout the world [*cf. R.A.E.*, A **19** 398; **23** 242]. *C. striatum*, Thorpe [*cf.* preceding abstract] was discovered attacking *A. maximus*. The body wall of the well-grown host is pierced by the ovipositor of the fly, and the eggs are placed in numbers in the haemocoele. The larvae feed on the blood and fat-body of the host. As they grow, they develop to a quite extraordinary degree the respiratory caudal processes that are so characteristic of the genus. These float in the blood of the host and act as tracheal gills, often being entangled among the tracheae of the host. In the third instar, they are packed with fine tracheal tubes and may be ten times the length of the body of the larva. The thickness of the dorsal cuticle of the host presumably renders emergence in the normal manner impossible. Instead, the insect pupates with its spiracles penetrating the thin membrane separating the haemocoele from the marsupium. The fly thus emerges into the marsupium and makes its way to the exterior by the same route as the newly hatched scales themselves.

The biology of *Cryptochetum tuberculatum*, Thorpe [*cf.* preceding abstract] is different, as it lives as a solitary endoparasite in the young stages of *Aspidoproctus bifurcatus*, Thorpe, and *A. glaber*, Ldgr. It has therefore no special difficulties of respiration and emergence to overcome; its caudal processes are much shorter and contain relatively few tracheae, and its mode of pupation is normal. The life-history of *Eupelmus aspidoprocti*, Ferrière [*cf.* next abstract], a Eupelmid parasite of *A. maximus*, is also described. The stalked egg is inserted through the body wall into the cavity of the marsupium, where the larvae feed on the developing eggs and young. Pupation takes place within the host, and the adult eats it way out dorsally.

FERRIÈRE (C.). **A new Coccid-parasite of the Family Eupelmidae (Hym. Chalc.).**—*Parasitology* **33** no. 2 pp. 169–171. London, 1941.

The adults of both sexes of *Eupelmus aspidoprocti*, sp. n., bred from *Aspidoproctus maximus*, Newst., in Tanganyika Territory [*cf.* preceding abstract] are described. The author states that it is not a typical *Eupelmus* and apparently shows affinities with several other genera. Characters distinguishing the genotypes of these from it are given.

Progress Reports from Experiment Stations Season 1939–1940.— Med. 8vo, vi+176 pp., ill. London, Emp. Cott. Gr. Corp., 1941. Price 3*s.* 0*d.*

The pests of cotton that occurred at various Experiment Stations during 1939–40 are discussed as in previous years [*cf. R.A.E.*, A **28** 525, etc.]. W. G. Wells reports (p. 8) that in Queensland, cotton was

attacked early by *Podagrica* (*Nisotra*) *breweri*, Baly, and *Chortoicetes terminifera*, Wlk. [*cf.* **29** 466], but the more important insect pests did not appear until the middle of the season. *Cosmophila* (*Anomis*) *flava*, F., and *Antarchaea chionosticta*, Turn., were more abundant than in recent years, and destroyed or damaged fairly large areas, except where a spray of 1 lb. lead arsenate, 1 gal. molasses and 12 gals. water was applied promptly. *Heliothis armigera*, Hb., was generally distributed, but affected yields appreciably only in late-planted crops in a few areas. The autumn infestation by *Empoasca terrae-reginae*, Paoli, was more localised than usual, and *Platyedra scutigera*, Hold., which seriously affected cotton harvested late in the previous season, was of slight importance.

A report on physiological work at Barberton, South Africa, by R. C. Rainey (pp. 39–46) includes notes on factors influencing the changes in susceptibility to attack by insects and fungi during boll development [*cf.* **28** 526]. In tests with *Dysdercus nigrofasciatus*, Stål, the adult males exhibited a marked preference for young bolls of high sugar content ; Pearson has shown that a plain sugar solution provides adequate food for the adults of this species, and that it is probably the nectar supplied by flowering trees of the Low Veldt during the latter part of the dry season that enables it to overwinter [*cf.* **27** 490]. Fifth-instar nymphs appeared to select somewhat older bolls, possibly on account of the greater amount of protein required for growth ; still older bolls were rejected, despite a further rise in protein, possibly on account of the declining water content or the hardening of the boll-wall. Nymphs in the third instar made few punctures, apparently feeding mainly on split bolls. The requirements of adult females appeared to be similar to those of the older nymphs ; it is probable that available protein is essential for egg maturation. A similar possible relationship between chemical composition and insect attack is indicated by the fact that larvae of *H. armigera* show a strong preference for the younger parts of the plant, in which the protein content is highest [*cf.* **28** 526]. Collections showed that about 13 per cent. of adults of *D. nigrofasciatus* and a smaller proportion of nymphs in the fifth instar were parasitised by Diptera. The relative importance of *D. fasciatus*, Sign., has continued to decline, probably owing to the reduction in the area of ratoon and standover cotton.

F. S. Parsons and J. Marshall (pp. 47–57) record further detailed studies at Barberton on the course of crop production on cotton in relation to losses from attack by *H. armigera* [*cf.* **28** 525]. Observations were made on the shedding of damaged and undamaged buds and bolls, the sites and stages of fruit destroyed, the sources of ripened bolls, the relative importance of fruiting sectors at times of attack and the times and degrees of recovery from attack of early, medium and medium-late strains, which were exposed to early, late and both early and late infestations. Light and heavy infestations were produced artificially in each generation, and natural infestation was so light that plots not infested by hand served as the control. Larvae of the second generation died without causing measurable damage [*cf. loc. cit.*]. The main attack by the first generation occurred in January, when soil moisture conditions were favourable, but there was no rain of value during February and the first half of March, so that growth and fruiting were restricted and premature ripening took place. With a negligible or light infestation, the early variety produced over 71 per cent. of its lint from bolls set in January and the remainder from those set in February.

Heavily infested plants produced 22 per cent. of their lint from bolls set in January and the remainder from those set in February or March. The early heavy loss of fruit relieved the plants during the drought and kept them in green growth longer, while they were producing a re-flush of buds, and later rains allowed maturation of a sufficient proportion of bolls to give final yields equal to those of the control and of the lightly infested plants. The heavily infested crop, however, matured so late that it was exposed considerably more to *Dysdercus* and diseases. The lightly infested plants of the medium strain produced the highest yield, from bolls set in February, but differences in this case were probably due more to irregularities of growth than to bollworm damage. The infestations of the latest strain led to later re-flushes of buds, which ultimately produced bolls giving yields almost equivalent to that of the control in the case of the light infestation and markedly in excess of it in the case of the heavy one. In attempts to reduce the heavy shedding of undamaged buds and bolls that occurs during re-flushes of buds after early attack by *H. armigera*, a top-dressing of 200 lb. per acre of sodium nitrate, applied one week before flowering, did not affect the number of bolls formed, but increased the number that matured and the yield. The courses of emergence at Barberton of adults from diapausing pupae of the red bollworm [*Diparopsis castanea*, Hmps.] collected locally and in Nyasaland were again in practical agreement [*cf.* **28** 526].

G. S. Cameron states (pp. 71–72) that in Southern Rhodesia, *Dysdercus fasciatus* was no longer so prevalent as *D. intermedius*, Dist., or *D. superstitiosus*, F. [*cf.* **28** 528]. *D. intermedius* was more numerous than *D. superstitiosus*, but both were present until the end of the season. The heaviest infestations were on the overgrown cotton on the better soils, but the damage was not serious. Other pests included Jassids, which were apparently numerous but not injurious in overgrown cotton on the richer soils at the end of the season, *H. armigera*, which is thought to have caused considerable damage, the Sudan bollworm [*Diparopsis castanea*], small numbers of which were present in April, and locusts.

From Uganda, it is reported by G. W. Nye (p. 81) that cotton was not seriously damaged by insects in the Kawanda district, and by J. D. Jameson (pp. 86–87) that infestation was very low in the Serere district, owing to the failure of the second rains, but that as the incidence of the pink bollworm [*Platyedra gossypiella*, Saund.] was high towards the end of the season, all cotton was uprooted and burnt as early as possible ; the crop ripened very rapidly, and an unusually long close season was achieved.

Observations on cotton pests were made at a number of experiment stations in Tanganyika Territory. J. E. Peat records (pp. 95–96) a certain amount of damage by *Lygus* and Jassids at low altitudes at Ukiriguru. Resistance to *Lygus* appeared to be associated with hairiness. Stainers caused little damage ; *Dysdercus superstitiosus* and *D. nigrofasciatus* attacked the crop later than usual, and *D. fasciatus* and *Calidea* spp. were later still. *D. fasciatus* breeds heavily round ginneries, ginnery wharfs and some seed-issuing centres, near which the crops are more heavily infested than usual, and it is recommended that such breeding centres should be cleaned up thoroughly at the end of each season. B. R. D. Eccles states (pp. 99–100) that *H. armigera* showed a marked preference for maize at all stages of growth at Nyamahona and did not migrate to cotton. Though maize was more heavily

infested than in any previous year, cotton was little affected, partly because the more attractive crop was planted in a contiguous plot. A. N. Prentice reports (pp. 104–106) that *Empoasca* sp., presumably *E. facialis*, Jac., was first noticed in the Shinyanga district at the beginning of February, but did not attack cotton severely until the rains in March. A very high standard of resistance to Jassids is essential in any cotton grown there. Boll-sucking insects were numerous and did much damage. *D. fasciatus* was the most plentiful of the stainers ; *D. intermedius*, *D. cardinalis*, Gerst., *D. superstitiosus* and *D. nigrofasciatus* were also present. Two species of *Calidea* appeared suddenly in mid-March and were numerous until they disappeared in early May. Heavy staining in the south-west of the district caused virtual failure of the cotton crop there, but the position improved towards the north-east. *H. armigera* and *Earias* sp. caused sporadic damage, and the dusky stainer, *Oxycarenus* sp., was the only other pest that was at all numerous. It is stated by A. H. McKinstry (pp. 112–114) that very heavy attack by *H. armigera* and Jassids caused almost complete failure of cotton at the Kingolwira experiment station, though that on neighbouring peasant holdings, which was planted about two weeks later, was little damaged. The earliness and comparatively large area of the station cotton probably made it an ideal trap-crop for the bollworm, the population of which was probably built up on early maize in the neighbourhood. It is, however, considered unlikely that *H. armigera* will often cause severe damage to cotton, owing to the variety of the crops grown and of planting dates and the richness of the indigenous vegetation in many areas. Small numbers of stainers, chiefly *D. cardinalis* and *D. intermedius*, were present on cotton soon after flowering began, and the first bolls to split showed symptoms of disease, probably caused by a small population possessed of a high degree of infectivity feeding on small numbers of young bolls.

Observations in Nyasaland, described by E. O. Pearson and B. L. Mitchell (pp. 124–136), were made to obtain comprehensive information on the nature and extent of the crop loss due to pests and diseases, particularly in the Lower River area, and the measurement of all factors affecting this loss. Routine population records, obtained from the Domira Bay Station and from native gardens in the Lake Shore area, showed that adults of the bollworm [*Diparopsis castanea*] emerging from pupae that had been in diapause since the previous season gave rise to a very small larval population, and a good crop was set before larvae of the next generation appeared at the end of March. There was a small immigration, unaccompanied by breeding, of a few hundred stainers, chiefly *Dysdercus intermedius*, per acre during March, and a larger immigration when the bolls were beginning to open in late April. Fifth-instar nymphs occurred 2–3 weeks later and were present at the rate of 17,000 per acre by June. Most of the adults dispersed very soon after the final moult, their peak population being only 3,000 per acre, and almost all left the fields from the middle of June onwards. *D. fasciatus* appeared in smaller numbers in late April and built up a considerable population in June ; the adults did not disperse, and the population in mid-July, when records ceased, was the highest for the season (4,000 adults and 12,000 fifth-instar nymphs per acre). It was found that 57 per cent. of the crop was derived from buds produced in the last fortnight of February, and 95 per cent. from those produced in the six weeks ending 23rd March, the first 43 per cent. of the buds formed producing 90 per cent. of the crop. Shedding of buds

and bolls due to *Diparopsis* was far less than that due to unknown causes, and probably did not involve any loss of crop. Of the bolls that set nearly half gave clean cotton ; *D. castanea* caused a loss of 10 per cent., and immaturity, direct attack by bacteria and *Dysdercus*, chiefly the immigrant population, 3½, 3½ and 38 per cent., respectively. There was no significant difference in yield from crops with one or three plants per hill ; the latter produced about 13 per cent. more flowers, but received nearly 25 per cent. more damage from *Dysdercus*. Observations on adult emergence from pupae of *Diparopsis* in 1939–40 confirmed those of the previous year [*cf.* **28** 528]. Very few emerged between the end of September and December, and 31 per cent. of those emerging from diapause later were present before the cotton crop was available for the larvae. Emergence from pupae formed at Barberton in May and buried in Nyasaland in pupal cages at depths of 1½ and 3 inches at the end of July ceased in the middle of September, when 10 and 20 per cent., respectively, had transformed ; the remainder are believed to be in diapause. It is probable that the sudden rise in temperature and fall in humidity that occur after September are responsible for the pupal diapause, and cage experiments showed that the mean depth of pupation, on which the temperature and humidity to which the pupae are subjected depend, increased from 1 inch in March to 2½ inches in June. Direct sampling of cotton fields confirmed that pupae are in the loose surface layer of soil, which is about 2½ inches deep, and about 2,000 per acre were found in diapause in November.

In the Lower River district, only 24 per cent. of the bolls that developed contributed to the crop, 46 and 28 per cent. being destroyed by *Diparopsis* and *Dysdercus*, respectively, and the remainder by other factors, including direct bacterial lesions ; 76 per cent. of the shed and abortive bolls were damaged by *Diparopsis*. There was considerable oviposition in March and part of April by moths emerging from diapause and those of the first generation bred in early cotton, and in late April, May and the first three weeks of June by those of the first generation bred in the main crop. It declined sharply from late June to the end of August or early September, owing to the cooler weather, which prolonged development and reduced the adult population, but there was renewed activity in September and October, due to emergence from overwintering but non-diapausing pupae. The larvae of the first generation to breed in the main crop cause a heavy loss of squares and young bolls, in the first fruiting period, which may be complete if there is a large proportion of early cotton in the neighbourhood or may be overcome by plants of vigorous growth ; these may produce a small crop before the cool season. The heavy larval population of the second generation in May and June causes a severe loss of partly grown bolls, but the decrease in activity from late June onwards permits the establishment of a crop from the June–July flowering, the extent of which depends on the time of planting and competition from the interplanted food-crop. Activity in September and October is of little importance as the bulk of the crop in these months is shed for physiological reasons.

There was an immigration of adults of *Dysdercus intermedius* in May and June, and the population reached 1,000–2,000 per acre in late May, but breeding was very restricted, and the adults dispersed from the fields as they matured. *D. fasciatus* occurred only in very small numbers, except in one area in which the population exceeded 1,000 per acre in mid-July ; there appeared to be a transient immigration of adults in late August. The greater part of the crop was planted in late

January or early February, and, owing to growing conditions and bollworm attack, there were few recently split bolls in May, so that the development of nymphs of *Dysdercus* was restricted until June or July, when the temperature is so low as to reduce breeding considerably; when the August crop was opening, the population was so low that it could not build up rapidly, especially under the conditions of rising heat and dryness at this time. Very early cotton sometimes escapes attack by *Diparopsis* and *Dysdercus*, but the later part of the early crop is severely damaged by both; cotton planted in February is attacked by *Dysdercus*, but less severely, and the late crop, from the second flowering of early plantings or the latter part of the main flowering of medium-late plantings, is relatively least damaged, as it passes through its most susceptible stage when stainer populations are at a minimum. The actual volume of damage recorded is considerably greater in the late crop than earlier in the season, possibly owing to a greater degree of infectivity of the stainers late in the season. It is concluded that the size of the moth flight from diapausing pupae, the amount of breeding in very early plantings and the extent to which activity is reduced in the cool weather determine the amount of damage caused by *Diparopsis*, and the size of the initial immigration to the crop, the amount of breeding on early plants and the extent to which breeding is inhibited during the cool season, that by *Dysdercus*. It was found that *Platyedra gossypiella* was present and spreading in the Lower River district, though it became conspicuous only towards the end of the season and probably did little damage.

It is stated by F. O. T. James (pp. 150–151) that the serious damage caused in a plantation in southern Nigeria in 1938–39 [**28** 529] by a species of *Helopeltis* [then recorded as *H. bergrothi*, Reut. (*cf.* **29** 515–516)] was much intensified in 1939–40.

H. R. Surridge (pp. 175–176) reports from Fiji that some damage was done to seedlings early in the season by cutworms; that *Earias fabia* Stoll, caused extensive injury on all cottons; and that *Platyedra gossypiella* was more prevalent than usual. *Tectocoris diophthalmus*, Thnb. (*lineola*, F.) was present in small numbers, but *Dysdercus insularis*, Stål, was not found, possibly owing to the early close season. *Nezara viridula*, L., occurred on young plants early in the season, but migrated to cowpeas and tobacco as the season advanced [*cf.* **29** 170]; it was not found to have caused boll rot. The Jassid, *Empoasca* sp., was the most destructive pest of all cottons [*cf.* **29** 147]; it appeared early and was active throughout the season.

Ripley (L. B.), Hepburn (G. A.) & Anderssen (E. E.). **Fruit-fly Migrations in the Kat River Valley.**—*Sci. Bull. Dep. Agric. For. S. Afr.* no. 204, 17 pp., 3 charts, 4 refs. Pretoria, 1940. Price 3*d*. [Recd. December 1941.]

Since observations made in 1933, after a severe outbreak of *Ceratitis capitata*, Wied., on *Citrus* in the Kat River District, showed that the larvae did not develop in *Citrus* fruits [*R.A.E.*, A **23** 607], further trapping experiments were carried out from the autumn of 1933 to that of 1935 on eight estates situated along the whole length of the Kat River Valley (40 miles) to determine whether such outbreaks, which occur chiefly in autumn and winter, are the result of mass migrations into the orchards or of temporary increased activity among flies that have filtered in gradually.

Most flies were trapped on hot, dry days following dewless nights in autumn and winter, and there was little or no catch on days when the shade temperature did not exceed 65°F. ; temperatures above 73°F. were favourable for trapping. The flies are very active at 80–90°F., but are known to become inactive at higher temperatures. The maximum daily temperature appeared to be of greater importance in determining activity than the minimum for the previous night or the mean for the 24 hours, and catches on days following dewless nights when the relative humidity was as low as 40 per cent. were greater than on those following dewless nights on which the relative humidity was between 80 and 90 per cent. Hot dry winds appeared to increase activity still further. High temperatures not associated with dry conditions did not result in large catches. Very few data on the effect of light were obtained, but the fly is active on warm cloudy days. The migration and increased activity theories are discussed in the light of the evidence obtained. The migration theory is preferred because it is considered unlikely that the flies would escape the notice of entomologists working in the orchards, and because many flies were present a day or two after effective control measures had been applied, heavy catches were not made on every hot, dry day following a dewless night, and the numbers of flies trapped were not always consistent throughout the whole area.

Orchards of deciduous fruit trees appear to be the main breeding source of invading flies, but certain winter-fruiting wild plants, notably the milkwood tree (*Sideroxylon inerme*) and prickly-pear (*Opuntia decumana*), are also of importance taken collectively. Observations on the age of females captured throughout the year (estimated from the stage of development of the eggs) showed that, despite much variability, it increased progressively throughout the winter, indicating that the main winter population did not emerge from winter fruits ; at times, however, even in late winter, there was a fairly large proportion of young flies that had probably developed in wild fruit. Nearly all the females taken during the summer were old. Persimmon [*Diospyros kaki*], although fruiting late and often harbouring large numbers of flies, is not concerned in their production, since the fruits are rarely attacked.

The immediate source of the migrating flies is uncertain. They rarely remain in deciduous orchards after the fruiting season, but migrate, probably to trees in leaf, especially those with available food in the form of honey-dew or fruit-juice. Small numbers were trapped in river-bush and prickly-pear thickets during the autumn and winter, but very few were taken in hill-side bush. There was no correlation between points at which mass migrations entered the *Citrus* orchards and the situations of the nearest deciduous fruit-trees, or between the occurrence of migrations and the presence of *Sideroxylon inerme*, *Celtis kraussiana* (of which one tree harbouring large numbers was found) or persimmons, on which the only large populations found outside the *Citrus* orchards at this time of year occurred. In all but one of the 27 invasions recorded during 1933–35, the flies entered the orchards on sides bordering the river ; near one estate, the number of flies trapped in the bush increased during and just before migrations. The large numbers of flies taking part in the migrations may be accounted for by the gathering together of a scattered population, possibly including flies previously distributed in the *Citrus* orchards, or by the arrival of flies from distant breeding grounds. Since low humidity was the only climatic factor associated with migration, and it is known that caged

flies die at temperatures above 80°F. unless given water, the authors suggest that the flies congregate by the river as a result of high evaporation and thirst. Attempts to correlate wind direction and invasion were unsuccessful. Concentrations of flies within the orchards may be related to the distribution of honey-dew, which is often patchy.

BROEKHUYSEN (G. J.). **Some Suggestions for the Control of Ants, especially the *Pheidole* or Brown House Ant.**—*Fmg in S. Afr.* 1941 repr. no. 4, 5 pp., 9 figs. Pretoria, 1941.

Brief notes are given on the habits and control of the ants that become pests, particularly in houses, in South Africa under suitable conditions, and characters are described enabling them to be readily distinguished. They comprise *Pheidole megacephala*, F., and *Iridomyrmex humilis*, Mayr, which are introduced species, *Anoplolepis custodiens*, F. Sm., and *Camponotus* spp., chiefly *C. maculatus*, F. The nests of all these ants can be destroyed by pouring petrol or carbon bisulphide into them. Other measures recommended against *Pheidole* are removing the stone slabs beneath which it prefers to nest or soaking the soil under them with a mixture of used motor oil and creosote (5 : 1), which should also be poured into cracks in floors from which the ants emerge ; distributing a bait of 8 lb. golden syrup and 0·7 oz. sodium arsenite dissolved in 5 pints water in small closed tins with holes punched in the sides, which was found to kill the ants in 1–4 days ; and dusting with sodium fluoride or spraying with an atomised mixture of pyrethrum and kerosene [*cf. R.A.E.*, A **23** 70]. Lawns heavily infested by this ant should be watered with a solution of 1 oz. sodium cyanide in 5 gals. water, or sprinkled with a mixture of Paris green and brown sugar (1 : 16), applied at the rate of 1 lb. per 1,000 sq. ft. ; a second dusting should follow 10 days later, if necessary. *I. humilis* can be controlled by similar methods. *A. custodiens*, which is carnivorous and destroys harmful insects, including termites, but, when numerous, becomes a pest of cattle and in houses, can be controlled by a poison, the preparation of which is described [**21** 278]. All three species foster Coccids on fruit trees, and should be prevented from reaching them by banding the trees with adhesive. *Camponotus* can be controlled by destroying its nests and by the baits recommended against the other ants. It is stated that a bait consisting of tartar emetic, sugar and water (1 : 10 : 100 by weight) has given good results against *Camponotus* in America. If its nests are among growing plants, they can be effectively and safely dealt with by pouring in soapy water containing 0·1 per cent. pyrethrum extract.

WIESMANN (R.). **Untersuchungen über die Biologie und Bekämpfung der Erdbeermilbe, *Tarsonemus pallidus* (*fragariae* Z.) Banks.** [Investigations on the Biology and Control of the Strawberry Mite, *T. pallidus*.]—*Landw. Jb. Schweiz* **55** pt. 3 pp. 259–329, 46 figs., 39 refs. Bern, 1941. (With a Summary in French.)

An account is given of further work in Switzerland [*cf. R.A.E.*, A **25** 484] on the bionomics and control of *Tarsonemus pallidus*, Banks, which is a serious pest of strawberry. The classification, nomenclature and geographical distribution of this mite are discussed, and descriptions of all stages, including the anatomy of the female, are

given. In view of the unusual form of the nymphal stage [*cf.* **25** 121], the author prefers to call it a pupa. The injury caused to cultivated strawberries is describe.d

At the end of September, the various stages were mostly in the young, folded leaves, but there were few eggs and a relatively large number of pupae. The mites began to migrate in mid-October, and by the end of the month nearly all were in their winter quarters in the leaf-sheaths, the folds of the young leaves, and the stem of the plant. All the immature stages and males were killed by the first frosts, and the females, which are the only stage to overwinter, became torpid at 4°C. [39·2°F.]. They were able to survive temperatures as low as −10°C. [14°F.], but the great majority (90 per cent. or more) die during the winter in nature, damp being probably more injurious than cold. There was no cessation of reproduction in mites overwintering on greenhouse strawberry plants, but no great increase occurred because the young, tender leaves required for abundant egg production are not available in winter.

The overwintered females resume activity when the vegetation period begins. The first eggs were observed in March, and the first larvae and pupae in April or May. In May, the females of the first summer generation appear, and the population then increases with a quickening sequence of generations until it reaches its peak in July–August. Males occur first in mid-June and reach their maximum abundance in August. The situation of the mites on the plant is always changing, because they endeavour to remain in the centre, where young, tender leaves provide food and there is sufficient moisture.

The durations of the developmental stages at various temperatures are recorded. The optimum temperatures were 22–26°C. [71·6–78·8°F.] for eggs, 28°C. [82·4°F.] for larvae, and 12–33°C. [53·6–91·4°F.] for pupae, and the lengths of the three stages at these temperatures were 4–5, 3 and 2–7 days, respectively. Total development required 10–11 days at an optimum between 23 and 28°C. [73·4 and 82·4°F.]. In mid-summer, the generations follow each other rapidly with a pre-oviposition period of only 2–3 days. There are about 7 generations a year, depending on temperature.

Laboratory investigations showed that the mites, and particularly the immature stages, are very susceptible to low relative humidity; the larvae, which are the most sensitive, did not survive at 75 per cent. when the temperature was 13–20°C. [55·4–68°F.]. The vital optimum for the mite lies between 90 and 100 per cent. relative humidity with temperatures of 12–27°C. [53·6–80·6°F.]. The dryness of several strawberry-growing districts of Switzerland maintains them free from infestation. The influence of temperature on infestation was studied by placing infested leaves on uninfested strawberry plants. At 4·5–7·5°C. [40·1–45·5°F.], the plants grew well and the young leaves unfolded without any injury, though a few eggs were laid at 7·5°C. At 10°C. [50°F.], only faint signs of infestation were seen after 25 days and the leaves developed almost unharmed, but all developmental stages of the mite were more or less numerous. At 13·5°C. [56·3°F.], injury was apparent after a few days; and at 17·5°C. [63·5°F.], it rapidly became serious. At 21 [69·8°F.], 24 and 28°C., the young leaves withered in 11 days owing to heavy attack, the optimum for which is at about 24°C. It is concluded that given suitable humidity, *T. pallidus* is very harmful at 13–24°C. [55·4–75·2°F.]. Outbreaks can occur when the relative humidity in the habitat of the mite is 85 per

cent. or over and when summer temperatures are not below 13–14°C. [55·4–57·2°F.].

Reproduction appears to be facultatively parthenogenetic. Males were rare in June and represented only 25–30 per cent. of the population in August. They usually fertilise the females before the latter have emerged from the pupal skin, and rarely pair with newly emerged females. The number of eggs deposited per female varied from 28 to 41. The length of life of the females depended largely on temperature. At 4°C. they survived in a state of torpor for over 3 months, after which observations ceased. They lived for an average of 1½ months at 12°C. and 30–33 days at 22°. Higher temperatures were harmful, and 38°C. [100·4°F.] proved fatal within a few days. Oviposition began at 8°C. [46·4°F.], reached its maximum at 22°C. and then decreased rapidly until it almost ceased at 33°C.

Experiments on the spread of infestation from plant to plant and field to field are described in detail. The mites were unable to spread along the ground, but migrated along the runners and from one plant to another in contact with it. They were not carried by birds or by rain, and carriage by wind and bees was negligible. The chief means by which infestation is spread is through the distribution of infested cuttings. The only natural enemy observed was a predacious mite [*cf.* **25** 121], which, however, was of no practical value.

The plants attacked by *T. pallidus* in various parts of the world are reviewed. In the author's investigations all of the 15 more important cultivated varieties of the garden strawberry were readily infested. Of many other plants exposed to the mite, the only ones infested were *Myosotis*, *Filipendula hexapetala*, blackberry (*Rubus fruticosus*) and several species of *Fragaria* and *Potentilla*, and it survived the winter only on *F. moschata* and *P. veitchii*. It is concluded that in Switzerland, alternative food-plants are of no practical importance.

A detailed account is given of further experiments on control by fumigation, in which methyl bromide (S-Gas) [*cf.* **25** 484] proved more satisfactory than other fumigants. The fumigation of plants growing in the soil by releasing the fumigant under a portable frame that was placed over them was found unsatisfactory, but complete control of the mite was given without injury to the plants by fumigating cuttings with methyl bromide at the rate of 2 vols. per cent. (equivalent to 1 oz. per 50 cu. ft.) at 20–25°C. [68–77°F.] for 6 hours in a fumigation chamber. This treatment has proved effective on a commercial scale.

Barnes (H. F.). **Studies in Fluctuations in Insect Populations. VIII. The Wheat Blossom Midges on Broadbalk, 1932–40, with a Discussion of the Results obtained 1927–40.**—*J. Anim. Ecol.* **10** no. 1 pp. 94–120, 8 figs., 8 refs. London, 1941.

The results obtained during the first five years' work on fluctuations in populations of *Contarinia tritici*, Kby., and *Sitodiplosis mosellana*, Géh., in a field of permanent wheat, begun at Harpenden in 1927, have already been noticed [*R.A.E.*, A **20** 484 ; **24** 57, 58] ; in this paper an account is given of those obtained in 1932–40, and the findings of the whole investigation are discussed.

Observations in an unheated outdoor insectary over a period of twelve years showed that the date of first emergence of *C. tritici* ranged from 30th May to 17th June, with a peak generally in 4th 24th June,

and that of *S. mosellana* from 29th May to 17th June, with a peak between 4th June and 1st July. These dates corresponded well with those observed in the field. In both species, females were rather more numerous than males, but the difference was slight in adults of *C. tritici* that emerged in August and September [**20** 485]. Adults emerged in August and September in 11 of the 13 summers under observation, and bred on couch grass *Agropyrum* (*Triticum*) *repens*. The percentage emergence of adults from larvae obtained in the preceding year varied from 3 to 66 in *C. tritici* and from 4 to 60 in *S. mosellana*. Evidence was obtained that larvae of *C. tritici* sometimes overwinter twice and those of *S. mosellana* two or three times. *C. tritici* was successfully reared on couch grass, slender foxtail grass (*Alopecurus myosuroides*) and rye, but not on rye grass (*Lolium perenne*), meadow foxtail grass (*A. pratensis*) or timothy grass (*Phleum pratense*), although on one occasion oviposition took place on the latter.

The following is largely taken from the author's summary of the results for the whole period. The date of emergence of both species is correlated with the emergence of the wheat ears, and it appears that both are correlated with the harvesting dates. There seem to be cycles (covering about five years) of abundance of the two species, considered either separately or together. In both species, years in which larvae are numerous are followed by years of high relative parasitism and years of low larval populations by years of low relative parasitism. High relative parasitism accompanies low winter survival of hosts and parasites, and low relative parasitism accompanies high winter survival. The percentage of infested grain is negatively correlated with the yield of wheat. If there is no adequate compensation in attacked wheat ears before harvest, the midges must be considered as pests, but if compensation does take place, the numbers of larvae can be regarded only as an indication of the size of yield or a measure of those climatic conditions during the previous months that influence yield. Since the larvae of *C. tritici* feed on sap rising to form the grain, whereas those of *S. mosellana* feed on the sap in newly formed grain, which becomes shrunken, compensation is less likely to take place after attack by *S. mosellana*.

The intensity of attack was not affected by manuring. One year's fallowing reduced infestation, although this was somewhat masked in the area studied by positional differences in infestation, one part of the field being always comparatively more heavily infested than the rest. This effect of fallowing seems to disappear by the third successive crop, *i.e.* infestation by both species is increased where rotation is not practised.

Roy (D. N.). **Infestation of manufactured Food by Insects.**—*Nature* **147** no. 3737 p. 746, 2 refs. London, 1941.

Munro (J. W.). **Infestation of manufactured Food by Insects.**—*Nature* **147** no. 3739 p. 808. London, 1941.

The author of the first of these notes states that many bottles in different consignments of a proprietary invalid food manufactured in England were found in India to have become infested with *Tribolium castaneum*, Hbst., and *Oryzaephilus* (*Sylvanus*) *surinamensis*, L. The food was prepared from malted cereals and wheat flour, and in the process was subjected to heat not exceeding 170°F. and also to drying

in vacuo. On examination, the waxed paper used to seal the bottles was apparently intact, although beetles, many of which were dead, were observed in the bottles. Infestation was accompanied by solidification of the food, but since in a few samples solidification occurred when there was no trace of the beetles, it is assumed that the bottles were not hermetically sealed. Experiments showed that the infestation could not have been caused by larvae entering before the food was bottled, since exposure for 1 hour to 125°F. was found to be fatal to all stages of the insects. Infestation presumably occurs after bottling, since it was stated locally that an absolutely fresh consignment is very rarely infested. The cover of one bottle was loose in two places. In experiments, starved larvae and adults did not enter a bottle of food through a well-sealed cover, and their inability to do so was supported by the fact that when sealed in a bag of thin paper, which was then buried in flour dust, the larvae and adults were not able to eat their way out of the bag and died of starvation. It seems evident that the insects reach the food through crannies left in the sealing and not by gnawing through the cover.

Both species are cosmopolitan, and invasion of the food might occur in England, on the sea or in India. As larval skins were detected in the solidified material and especially on the outside of the waxed paper used for sealing, it seems probable that invasion occurs in the larval stage. Both sexes of the beetles were present, but reproduction did not occur, although normally it is continuous in the tropics. The use of the proper seal is extremely important, and sealing wax should be preferred to ordinary wax, which is likely to work loose during transit.

In the second note, Munro points out that some years ago he investigated the cause of the infestation of a manufactured commodity similar to, if not identical with, that referred to by Roy. It was concluded that as precautions had been taken to ensure bottling of the commodity under sterile conditions, the method of sealing was at fault. Evidence indicated that infestation might occur at almost any stage in the marketing of the commodity, and that a most likely point was the Indian warehouses, in which *Oryzaephilus* and *Tribolium* are reported to be abundant.

BRAITHWAITE (J. D.). **Entomological Research.**—*Rep. Silv. Ent. Burma 1939–40* pp. 99–113. Rangoon, 1941.

Investigations on the life-history of *Xyleutes ceramicus*, Wlk., on teak [*Tectona grandis*] were continued in Burma in 1939–40. Young larvae in a cage at Zibingyi [*cf. R.A.E.*, A **29** 76] failed to complete their development, and comparison with experiments under more protected conditions indicated that wind and rain must have important lethal and distributive effects on the small larvae. In 1940, on an observation plot containing nearly 900 trees, 90 emergence holes were found in 48 trees, and 21 males and 34 females emerged between 18th March and 18th April; there was no emergence during cold wet weather from 19th to 24th March. The males lived for 2–4 days and the females for 2–7; they appeared to fly at any time after emergence. Mating occurred generally on the night of emergence, but sometimes not until the second night, and oviposition began the night after mating and usually continued for two nights. The incubation period lasted 12–16 days. Work on the distribution of parasitism of *Xyleutes* by

Nemeritis tectonae, Perkins, was discontinued, but it was found that the species of *Indarbela*, probably *I. quadrinotata*, Wlk., that is an alternative host of this Ichneumonid, passes its larval stage in the small wood of *Xylia dolabriformis* and other trees, and therefore occurs in large numbers at the same height as the parasite [*cf. loc. cit.*].

The teak defoliators, *Hyblaea puera*, Cram., and *Hapalia machaeralis*, Wlk., were abundant in August, instead of in May–June and October-December, respectively. Attacks by *Hyblaea* were more numerous but less severe than those by *Hapalia*. Records during a period of 12 years indicate that *Hapalia* is more injurious in dry localities than in wet ones; a heavy rainfall in August gives considerable control of this species, whereas an unusually light rainfall in May appears to produce conditions unfavourable for *Hyblaea*. Continued field collections showed that the percentage parasitism of various stages of *Hapalia machaeralis* increased with the density of the host population. No new egg parasites were found [*cf.* **29** 77]. Larvae were most heavily parasitised by *Apanteles machaeralis*, Wlkn., *Phanerotoma hendecasiella*, Cam., and Tachinids, including *Sturmia inconspicuella*, Baranov, *S. nigribarbis*, Baranov, *Nemorilla floralis*, Fall., and *Ptychomyia remota*, Aldr., and pupae by *Zenillia roseanella*, Baranov, *Angitia* (*Dioctes*) sp. and *A.* (*D.*) *argenteopilosa*, Cam. Parasitism of *Hyblaea puera* in the field was lower than in the previous year and occurred only during April–July. *Trichogrammatoidea nana*, Zhnt., was the only egg parasite and *S. inconspicuella*, the most frequent larval parasite; the pupae were parasitised chiefly by *Brachymeria euploeae*, Westw., *Echthromorpha notulatoria*, F., and unidentified Tachinids. *Cedria paradoxa*, Wlkn., the introduced parasite of *Hapalia*, appears to be established and spreading, since it was recovered five times, once 20 miles from a liberation point, and breeding and colonisation were therefore continued [*cf.* **29** 77]. It has been bred in the insectary on *Maruca testulalis*, Geyer, and on an unidentified Pyralid; full-grown larvae of *Indarbela* were attacked, but the parasites did not develop. A list of 22 other defoliators of teak and associated plants identified during the year includes an undescribed species of *Euproctis*, *Eriboea arja*, Fldr., and *Dasychira pennatula*, F., on teak. The species of *Indarbela* identified as *I. quadrinotata* has been recorded from teak, and *Alcidodes* (*Alcides*) *ludificator*, Fst., killed a high proportion of leading shoots in the plantations of one division. It is thought that attack by this weevil follows that by *Hyblaea* and *Hapalia*, the shoots starved by the reflush of leaves being particularly susceptible.

A list is given of ten further leaf-eating Lepidoptera recorded from *Xylia dolabriformis* during the year [*cf.* **29** 78]. They are not of importance, the principal defoliators being *Maruca testulalis* and *Striglina scitaria*, Wlk., which appear to occur in association throughout Burma and to remain active all the year, though outbreaks are confined to the period July–November, and *Achaea janata*, L., which is widely distributed and most injurious in May–July. The borers that infest this tree include the Cerambycids, *Pachydissus birmanicus*, Gardner [*cf.* **29** 77], *P. xyliae*, Fisher, and *Noserius tibialis*, Pasc., as well as *Zeuzera coffeae*, Nietn., and the species of *Indarbela*. Continued investigations on *Indarbela* showed that there is only one generation in the year; the small larvae previously recorded [as present in February 1939 (*cf.* **29** 78)] were found to be those of a Pyralid. There are probably several well-defined species of *Indarbela* with very similar life-histories; they have been recorded from 15 trees, a list of which is

given. The eggs are laid on the bark in masses of 15–20, and hatch in 13-15 days. The larvae bore into the wood and pupate in February or March. The optimum height at which trees are attacked is 15–20 ft., and laboratory experiments showed that wood less than 6 inches in circumference is not entered. The adults emerge over a period of about a month in March–April and live for about four days. The females have an average egg capacity of 964, and oviposition begins on the night after mating.

Observations on the life-history of *Xyleutes persona*, Le Guillou, which bores in living *Cassia*, were continued. In Rangoon, 63 adults emerged from 22 trees ; emergence occurred in every month except May and July, but was most abundant in February, September and October. The adults lived 6–16 days in cages and the incubation period was 11 days. In Maymyo, maximum emergence occurred in April, May and October ; one female was taken at light in late May. An unidentified Lyctid was bred from a billet of *Cassia fistula*. Two new defoliators of tung [*Aleurites*] were identified as *Thosea sinensis*, Wlk., and *Euproctis fraterna*, Moore ; they do not appear to be of great importance.

A survey of the insects attacking *Lantana camara* in Burma was begun during the year. *Platyptilia pusillidactyla*, Wlk., was present in considerable numbers, but the distribution of *Agromyza* (*Ophiomyia*) *lantanae*, Frogg., was very localised, and it is apparently parasitised by at least three unidentified Chalcidoids. The larvae of an unidentified Hepialid were found boring into the pith of *Lantana* and living on the cambium of the larger stems, which were sometimes completely girdled. Pupation takes place in the gallery, and a Braconid parasite has been observed. Neither the Agromyzid nor the Hepialid is sufficiently abundant to control the weed.

DIAKONOFF (A.). **Remarks on a predatory Bug (Hem., Anthocoridae).**—*Ent. Meded. Ned.-Ind.* **6** no. 3–4 pp. 55–56, 1 pl. Buitenzorg, 1940. **Bladscheedewants, een vijand van boorderrupsen.** [A Leaf-sheath Bug Enemy of Borer Larvae.]—*Arch. Suikerind. Ned. & Ned.-Ind.* **2** no. 9 pp. 205–213, 9 figs., 5 refs. Pasoeroean, 1941. (With a Summary in English.)

In the first paper, the author describes both sexes, with special reference to the genitalia of the male, of a predacious Anthocorid found in sugar-cane fields in Java, which he believed to be *Orius* (*Triphleps*) *persequens*, White. In the second paper he states that he has been informed by H. G. Barber that it is very probably *Scoloposcelis parallelus*, Motsch., and describes its bionomics.

The eggs are easily overlooked, since they are laid in the tissue of the inner side of the leaf-sheath, only the top being visible from the exterior. They are deposited in batches of up to 8, usually 1-3, and females laid up to 11 batches. The egg and nymphal stages lasted about 8 and 12–35 days, respectively, and the adults lived for up to 65 days. Both the nymphs and the adults are predacious, and the newly-hatched nymphs are able to attack young larvae of sugar-cane moth borers, though they are much smaller than the latter. The adults, which are briefly described, are very active. They seek their prey in the morning, and when the day becomes warm they shelter behind the leaf-sheaths. When disturbed and shelter is not available, they fly away. In the laboratory, this bug showed a preference for the young larvae of

Scirpophaga nivella, F. (*auriflua*, Zell.), *S. intacta*, Sn., *Diatraea venosata*, Wlk. (*striatalis*, Sn.), *D. auricilia*, Dudgn., and *Pyrausta nubilalis*, Hb., and also attacked *Aphis gossypii*, Glov., *A.* (*Longiunguis*) *sacchari*, Zhnt., *Oregma lanigera*, Zhnt., and nymphs of *Trionymus sacchari*, Ckll. Bugs that were given the eggs and nymphs of Delphacids did not attack them and died of starvation. No parasites of the bug were found, but the nymphs of a Tyroglyphid mite, which are briefly described, are carried by it.

DANIEL (D. M.). **Oriental Fruit Moth.**—*Proc. N. Y. St. hort. Soc.* **86** pp. 42–44. Le Roy, N.Y., 1941.

In Niagara County (New York State), the total number of peaches, the number damaged by larvae of the oriental fruit moth [*Cydia molesta*, Busck], and the number damaged by the third generation larvae averaged 653, 23·6 and 11·7 per tree in 1939 and 306, 77·2 and 21·8 in 1940.

When harvesting of early peaches began at the beginning of August 1940, 10–20 per cent. of the fruits had been injured by first-generation larvae. This unusually high percentage was due to the prolonged period of first-generation activity, which, as a result of abnormally high temperatures during the first 18 days of June being preceded and followed by abnormally low temperatures in May and from 19th June to 17th July, extended over a period of 6 weeks, ending on 20th July, whereas in normal years the second generation is completed by 1st August. During the first part of July, considerable numbers of first-generation larvae were observed to be leaving the twigs and entering the immature fruits, and there appeared to be more of this activity than usual. Weekly counts made until harvest established that the second generation larvae fed almost exclusively on twigs. Parasites were very plentiful at this time, and although injury to the fruits by the third generation was greater than in 1939, it is not considered to have been excessive.

CHAPMAN (P. J.). **New Facts about Oil Sprays.**—*Proc. N. Y. St. hort. Soc.* **86** pp. 213-217. Le Roy, N.Y., 1941.

Recent studies in New York State have shown that control of such orchard pests as San José scale [*Aspidiotus perniciosus*, Comst.], European red mite [*Paratetranychus pilosus*, C. & F.], fruit-tree leaf-roller [*Tortrix argyrospila*, Wlk.] and the apple red bug [*Lygidea mendax*, Reut.] by dormant oil sprays is related fairly directly with the amount of oil deposited on the tree. The most important factors affecting the amount of deposit appear to be oil concentration (in sprays prepared with the same emulsifier), the kind and amount of emulsifier employed, and the quantity of spray applied to the tree. Experiments have shown that a spray containing $1\frac{1}{2}$ per cent. oil emulsified with skim-milk powder leaves a deposit approximately equal to that left by one containing 6 per cent. oil emulsified with sulphite lye (Goulac). Skim-milk powder does not produce a stable mixture, however, and may give unsatisfactory results if spraying is not properly performed. The emulsifier recommended is blood albumen, at the rate of 2 oz. per 100 U.S. gals. spray, as it produces a fairly stable emulsion that spreads well and yet permits a fairly heavy deposit of oil. The amount of deposit on the bark, tree injury

and percentage control of *T. argyrospila* given by sprays containing 1–12 per cent. oil emulsified with blood albumen at the recommended rate are shown in a table; a spray containing 4 per cent. oil gave 99 per cent. control without injuring the trees. The percentage control of *T. argyrospila* and *L. mendax* and the amount of deposit given by nine proprietary oil emulsions and emulsible oils and a tank-mixed oil emulsion prepared with blood albumen at the recommended rate are given in another table.

It has also been shown that a single application of twice the amount of spray required for complete coverage results in an increase in deposit of only one-third, but that the amount of deposit is doubled when two applications of the usual amount are made and the first is allowed to dry before the second is applied. Where the practice of spraying the windward side of the trees on one day and the other side when the wind is in the opposite direction is followed, part of each tree receives a double deposit, and this may cause injury if the oil content of the spray is high.

Instructions for applying dormant oil sprays are appended.

VAN ALSTYNE (A.). **A new Kind of Codling Moth Control.**—*Proc. N. Y. St. hort. Soc.* **86** pp. 328–330. Le Roy, N.Y., 1941.

An account is given of a successful attempt by a grower to control the codling moth [*Cydia pomonella*, L.] on apple in New York State in 1940 by means of careful and thorough spraying to prevent infestation by the first generation. The work was done on a property on which the larvae had caused increasingly serious damage during the previous five years and appeared to have acquired a considerable amount of resistance to lead arsenate. For this reason, free nicotine was included in all the five sprays applied, to kill the adults of the overwintered generation and some of the resistant larvae [*cf. R.A.E.*, A **26** 554; **28** 519; **29** 634]. Lead arsenate was also included in the first two sprays, summer oil in the other three, and fixed nicotine in the third and fourth. The sprays were applied in an orchard of large trees on 10th, 17th and 26th June and 5th and 17th July; the fifth application was necessary because cool weather prolonged activity by the first generation. Two men operated single spray guns, one from the top of the spray tank and the other from the platform at the back of the equipment, and a third, operating a broom gun, was stationed at the top of a high tower built on to it; the equipment was driven round each tree, which received 25–35 U.S. gals. spray. The free nicotine was omitted from the sprays applied to some small trees near the main orchard, and the apples from these showed many more superficial injuries than did those from the large orchard trees. Several apples containing second-generation larvae were found beneath two trees in the orchard that were too close together to allow spraying equipment to pass between them; injury by larvae of the second generation was not so difficult to find in their immediate vicinity as it was elsewhere.

PAPER NOTICED BY TITLE ONLY.

Specifications and Methods of Analysis for Tar Oil Winter Washes.—*Bull. Minist. Agric.* no. 122, iv+22 pp. London, 1941. Price 6*d* net.

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